November 17, 1921

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGraw-Hill Company, Inc.

In this issue—

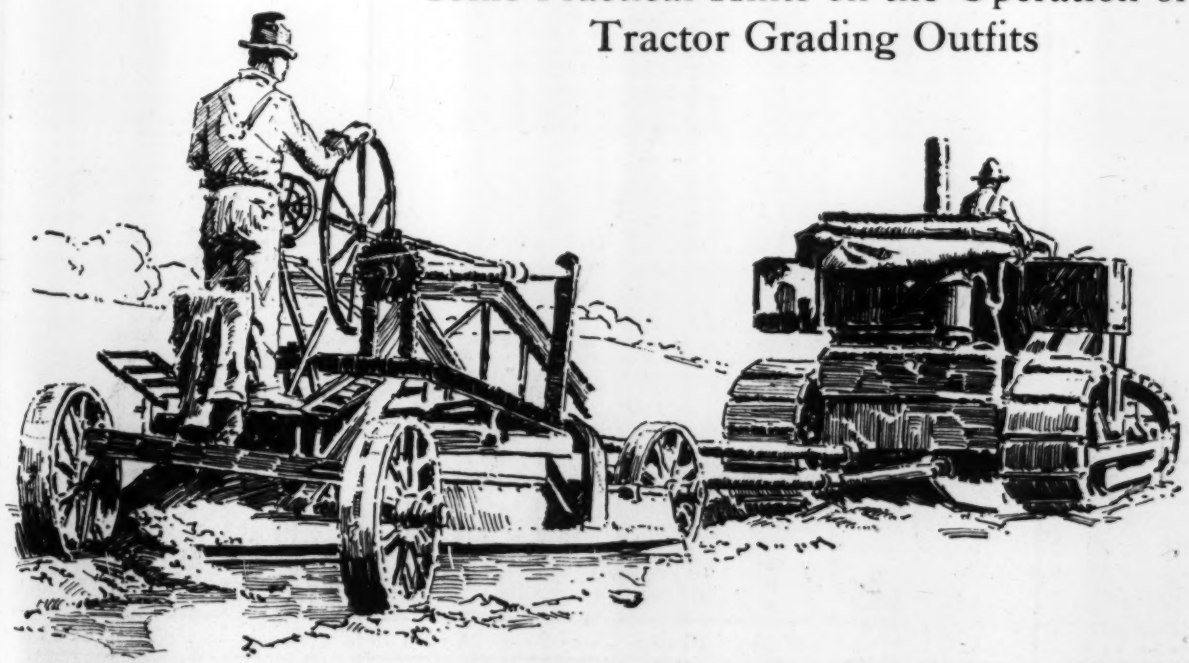
Practical Use of Excess Sand Method of Proportioning Concrete for Iowa State Roads
R. W. Crum

Building a Cofferdam for a Dry Dock at St. John, N. B. In a 28-foot Tide Variation
H. E. Huestis

Design Data for a 17x18-foot Double-Box Pressure Sewer at Kansas City
A. D. Ludlow

and—

Some Practical Hints on the Operation of Tractor Grading Outfits



Brownhoist No. 2 Gasoline Engine Crane operates with gasoline or kerosene

Saving Thousands of Dollars With a Brownhoist Crane

One manufacturer, for example, finds that his Brownhoist displaces a force of 50 men in unloading incoming raw material from railroad cars.

Equally worth-while savings are effected in loading finished products; in handling coal, coke and scrap; in switching cars, and in a multitude of other handling jobs.

Brownhoist No. 2 costs less than $15 a day. This cost includes operation, upkeep, taxes, interest and depreciation.

If you are eager to cut your material handling costs, our new booklet "Man-Power Multiplied" will show the way. A postal to us will put it on your desk.

The Brown Hoisting Machinery Co., *Cleveland, Ohio*

Branches: New York, Chicago, Pittsburg, San Francisco, New Orleans.

Other Products—Grab Buckets, Electric Hoists, Trolleys, Overhead Cranes, Bridge Cranes, Heavy Dock Machinery.

BROWNHOIST

LOCOMOTIVE CRANES AND HOISTING DEVICES

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN
Editor

Volume 87 — NEW YORK, NOVEMBER 17, 1921 — Number 20

The Disarmament Proposals

It was a stroke worthy of a nation with disinterested motives to propose, in the opening address of the conference on the limitation of armaments, the scrapping of 66 capital ships. The boldness of the proposal and the challenge it gives to the intentions of other nations is an augury of a successful outcome of the conference in Washington. The start is a good one—worthy of a nation with America's peace traditions. It will hearten all who pray for a successful outcome of the negotiations.

Common Sense Versus Vaporings

REFERENCE was made in these columns last week to the addresses being made by Mr. Rowntree. One of these was delivered at a dinner, of over 1,000 covers, of the Academy of Social Science of New York. On the same program was Hugh Frayne, general organizer of the American Federation of Labor, who was expected to give labor's viewpoint on the elimination or mitigation of industrial unrest. It was an occasion for solid thought. Mr. Rowntree stuck to common sense. He was definite. His subject had a solid appeal. Here was a great occasion for the federation to appeal to an influential group interested in working toward a sound solution of the labor problem. Yet Mr. Frayne indulged in generalities. His speech was of the spread-eagle variety that would make a hit at a union picnic. There was no substance; nothing concrete. The sad part is not that this is an isolated case of lack of judgment in suiting the theme to the audience, but is typical of the fighting policy of the federation which excludes, apparently the development of policies that are economically defensible and that would win public support for organized labor. So long as the federation continues under its present unstatesman-like leadership, it cannot expect to regain or improve on the ground lost in recent years.

Double Side-Slab Roads

THE use of two side-slabs of concrete to replace a considerable mileage of old waterbound macadam in New York offers a method, where funds are limited, of securing a wide paved road at the cost of a comparatively narrow one-slab concrete road. Little criticism can be made of the design except on the count of increased maintenance. It gives a road with plenty of turnout room and, in case of need, for three-way traffic. It keeps the normal two lines of traffic well separated, and therefore increases the degree of safety. Maintenance will be increased. The center strip of penetration macadam, in the New York practice, breaks down sooner than the concrete, and particularly at the edges requires rather constant repairing. In rebuttal it may be said, however, that the narrow concrete slabs will probably develop fewer cracks than will a single slab 18 to 20 ft. wide, and that the reduction in crack-filling will counterbalance in part at least the extra cost of repairs on the penetration macadam. A final thought to be kept in mind is that the parallel slab road is a reconstruction design. Its fitness and its cheapness as a main road structure result largely from the fact that an old macadam pavement is in place as a foundation for the concrete slabs and for the macadam center strip.

Intimidation Enjoined

TWO recently issued injunctions against strikers emphasize a solid point of view toward the conduct of strikes. The one was at Raleigh, N. C., in connection with a strike in the printing trade, the other in the milk strike at New York City. The purport of the injunctions is the same—that no means may be used by the strikers to annoy or threaten those who remain at or return to work. There is left to them only strictly peaceful means of procedure. By detailed statement all the usual methods of bringing pressure on loyal employees or strike breakers are enjoined. The North Carolina court, for example, as two of the specific prohibitions, forbids the strikers, (1) "From following after the complaining employees (the injuction was sought by the employees who continued working) or any other employees of the printing companies for the purpose of worrying, harassing or disturbing them, or for the purpose of talking to them on the subject of their employment if said employees shall notify the defendants that they do not want to be talked to on this subject. (2) From using any threats, gestures, or engaging in any conduct of any kind calculated to disturb, annoy or put in fear any of the complainants herein." The New York decision is equally specific. Heretofore, "peaceful" picketing has been held legal. The intent of these injunctions evidently, is to prevent so-called "peaceful" picketing from becoming a means of intimidation. If the North Carolina and New York views as to the proper limits of methods of strikebreaking become general, the only means left to strikers to gain their point would be the obvious conferences with employers, the inconvenience and loss to owners resulting from the stoppage, the presentation of their case to the public through various channels of publicity, and the use of various official agencies for mediation. This is as it should be, and is demanded by our constitutional guarantees. The wonder is that such sweeping prohibitions of all means of instilling fear in the minds of those who work have not become general before.

Maintaining Worker's Standards

RESISTANCE to accepting lower standards—or to what are believed to be lower standards of living—is bound to be strong. This has been forcefully illustrated during this period of depression. Men applying for work at agencies frequently go away without taking jobs, though many are available, because they refuse to accept the lower wage scale now prevalent to do work that they consider of a lower order, or to work under less favorable conditions. This desire to maintain a higher standard is laudable, but in times like the pres-

ent, men must temporarily take what they can get, trusting to better times to permit them to return to their former standards. Another phase of this unwillingness to change standards was illustrated this summer on the construction work on the Catskill aqueduct. It was difficult to maintain full forces due to the unwillingness of men to work in isolated places. It is quite likely that with the curtailment of immigration this difficulty of filling forces on isolated jobs is likely to become widespread. The obvious effect will be to force a higher wage scale on the remote works.

Pit-Run Gravel Concrete Roads

PIT-RUN gravel mixtures have demonstrated their utility for concrete road construction to the satisfaction of the Iowa Highway Commission. This is a conclusion of immense importance to all in the states of the Mississippi Valley, and in all other states where the prevailing gravels have a sand content exceeding 30 to 40 per cent. In these states practically all the gravel deposits south of the Wisconsin drift area run small both in pebble content and in the size of the pebbles. A screened mixture from any of these gravels is excessively costly because of the great wastage of sand in screening. If screened materials in arbitrary proportions are rigidly demanded the coarse aggregate at least has to be imported, and importation cannot meet the demand both because means of transportation are not sufficient and because consumption in the few states having materials to export limits very narrowly the surplus available for a foreign market. All states are building roads, each to about the limit of capacity of mercantile producers to furnish materials, so that none can materially aid another which lacks materials.

These facts must be kept in mind in passing comment on a practice which by most highway engineers has come to be regarded as dangerous. It must also be remembered that the pit-run gravel concrete roads of Iowa are being constructed with a care and under a control by the laboratory which was not dreamed of when the pit-run gravel concrete roads which have so disastrously gone to pieces in New York and other Eastern states were built. The impulse to criticize is modified as this care in controlling the construction is comprehended and as the vital fact is realized that concrete roads in Iowa would cost more in many cases and could not be built in some cases unless excess-sand aggregates could be utilized.

Cleveland Leads Big Cities in Adopting City-Manager Plan

OPPONENTS of the city-manager plan who have been confronted with proof that it has been a marked success where tried have urged that it might do for small cities but would never work for large ones. This argument has been persisted in nothwithstanding the fact that four cities with over 100,000 population have prospered under city managers for considerable periods: Akron, Ohio, with 208,000 population; Dayton, Ohio, 153,000; Grand Rapids, Mich., 138,000; Norfolk, Va., 116,000. Such reasoning did not deter the voters of Cleveland, with its population of 797,000, from adopting the manager plan by a decisive vote on Nov. 8.

It should be noted that the amendments to the Cleveland charter meet one of the most valid of the arguments brought against the commission-manager plan for a large city, which is that a commission or council of only five members is not truly representative. This charge was met several years ago by Richard S. Childs and other advocates of commission-manager government by proposing that the larger cities should be divided into "wieldy districts," the number of districts depending upon the total size of the city and other local conditions, each district to be represented on the commission. Not only has this plan been adopted at Cleveland, but also proportional representation, after Jan. 1, 1924, by which the Council will consist of 25 members, chosen by proportional representation from four districts.

The extension of the city-manager plan to a city rapidly approaching a million people promises much in terms of municipal efficiency and of opportunity to engineers—the latter because better city government means the employment of more engineers, under improved conditions, even if the manager himself be not an engineer. It may also be noted in passing that a large percentage of the two hundred or more city managerships already in existence are filled by engineers.

In both opportunity and emolument the city managership of Cleveland should and probably will be the most important appointive municipal executive in the United States. To the highest type of men the opportunity will outweigh the emolument, whatever the latter may be.

The citizens of Cleveland should not rest content with the mere adoption of the city-manager plan, for that is only the beginning of what must be done to reap all its possible benefits. No matter how excellent the machinery of government provided in moments or days of zeal the people of any city must choose fit men to select its chief operator, to determine the policies he is to execute and to see that those policies are carried out; otherwise inefficiency and disaster will come soon or late—generally soon. True as all this is, it is no argument against adopting the best possible machinery of government yet devised—and this, for the city of today, provides for a chief engineer who goes under the name of city manager, whether he be an engineer in fact or merely in executive efficiency.

Specifying Concrete Proportions

IN THE discussion of the Progress Report of the Joint Committee on Concrete and Reinforced Concrete before the American Society of Civil Engineers on Dec. 7 and 8 no subject will receive more attention than the alternate provisions for proportioning. That clause which requires concrete of a given strength and workability and permits the contractor to produce such concrete as he pleases will be especially attacked by the contracting fraternity as unfair and unworkable, or at least tending toward an added expense without compensating improvements in quality. There is a fair question whether the committee has not gone ahead of the state of the art in this clause.

The technic of concrete manufacture has progressed remarkably in the past few years. Cement has been improved and standardized, aggregate selection and grading have approached a scientific basis, proportioning is no longer by rule-of-thumb and mixing and placing are regulated by proved rules. The variations in strength from batch to batch of the best concrete are measurably less than they were a decade ago in some of those structures whose present appearance is beginning to worry engineers. Indeed on some recent jobs where most attention has been paid to the production of the concrete, predicted strengths have been reached with

startling regularity. Study and experimentation are beginning to show in the improvement of the uniformity of the product.

With all this, however, concrete must continue to be a field made product, with all the deficiencies that involves. Its very formation is a chemical action that is not too well understood, unknown factors still affect its strength and the human element, always uncertain, enters largely into its makeup. In spite, therefore, of the great mprovements in the art of making concrete it is hardly fair for the engineer to require the contractor to take all of the responsibility for the strength of the concrete, unless he is prepared to make that required strength far enough below what he may reasonably expect as an average to take care of the inevitable variations that will occur, which obviously would be uneconomical.

Two practical questions also suggest themselves. Is the individual specimen test a complete indication of the strength of the mass and what is to be done about the concrete in the structure the test pieces for which show a strength deficiency at the end of say a 28-day period? It is well known that most concrete cut from structures shows a higher strength than the test pieces poured of the same concrete simultaneously with the placing. Different conditions of curing, the added pressure of the superposed concrete in the structure, the blending of successive batches, all have something to do with this. It would hardly be practicable to order the removal of concrete once placed because of a small reduction from the prescribed strength and it would be most difficult to set a limit of tolerance because of the unknown coefficient of superiority of the structural over the test concrete Furthermore, few structures are of such a nature that concrete placed a month ago can be removed today, without wrecking the structure.

The criticized clause, it will be noted, is merely an alternate. The engineer who employs it in a specification is apt to store up for himself a great deal of trouble. In the first place he must give up a great portion of his powers of supervision, for he cannot well say that the contractor must produce concrete of a certain strength and then tell him how he is to get that strength. Therefore any regulations as to proportions, quality of material, amount of water, time of mixing—all of which influence strength—must be left out of the specification. Will the engineer be willing to relinquish so much of his authority? Or to subject himself to the possibility of a high bid on the one hand from the good contractor who wants to take care of all possibilities or of a deficient structure which must be removed if the contract is let to one who is willing to take a chance?

Constructive Progress in New Highway Act

OF GREATER importance than the appropriation of $75,000,000 of government funds for road construction now and next year, as provided for in the Federal-Aid Highway Act which President Harding signed last week, is the assurance of the adoption, by the states, of sounder policies of highway location, financing, construction and maintenance than has existed in the past. To be sure, the additional funds are urgently needed in several of the states where the availability of state money has been contingent upon new federal-aid appropriations. This situation was brought out in several of the replies to *Engineering News-Record's* inquiry among state highway engineers as to policy regarding fall lettings.

Among the outstanding principles of logical highway administration which have been written into the new law are these: The designation of a system of highways comprising 7 per cent of the mileage of each state; the obligation of matching federal money with state funds under the direct control of the state highway department; the recognition of the need for maintenance and the provision of funds therefor; the centralization of control over road construction in the state rather than in its lesser political subdivisions, relief to the so-called public land states, assuring to them a more equitable distribution of federal funds; insistence upon roads of adequate width—18 ft., except in special cases. The establishment of such general principles marks a great forward step in highway administration and, as Senator Townsend has pointed out, precludes the probability of federal appropriations for road construction becoming subject to the "pork-barrel" charges which have been made against the government's river and harbor expenditures.

Perhaps the bitterest fight on any single feature of the new measure centered on the proposal of a federal highway commission to administer the work in place of the Secretary of Agriculture, through the U. S. Bureau of Public Roads. The commission plan was defeated and control will rest with the bureau which, during recent years, has demonstrated its ability to administer the work.

The passage of the bill, too, probably marks the end of the propaganda for a federal-built and maintained "national highway system." The federal-aid plan has come off victorious.

In the apportionment of federal aid to the states the former principle of a division on the basis of population, area, and mileage is followed, the only new feature being the stipulation that no state shall receive less than one-half of 1 per cent of the total funds, which, in the present case, amounts to $365,625. This provision increases the amounts formerly received by four of the smaller states, Delaware, New Hampshire, Rhode Island, and Vermont. The 7-per-cent road system which each state must select is divided into two classes—interstate and intercounty highways. The former comprises three-sevenths of the system and may receieve 60 per cent of the state's allotment of federal aid. The intercounty highways, constituting the remaining four-sevenths of the system selected, will receive the remainder of the state's allotment.

Coming at a time when unemployment is one of the country's pressing problems, the Federal Highway Act offers a substantial measure of relief by making possible the continuation of the highway programs of the states. It has been estimated that federal-aid road construction is giving employment to 250,000 men either directly or in the production and transportation of materials. Without a new distribution of federal funds, many of the state highway departments would have been forced to curtail, or in some cases to halt, their road-construction programs. These contingencies, happily, have been avoided.

The thought should be emphasized, too, that the appropriation allows highway development to proceed without chaotic interruption. In any enterprise as large as our highway-building program continuity of policy and work is necessary if efficiency is to be maintained.

Practical Hints on Operation and Maintenance

Tractor Grading Outfits

THIS article contains suggestions for selecting, operating and maintaining tractor grading equipment. These suggestions are a summary of the best experience of users and manufacturers. The information is of particular value now when the change from teams to tractors is gathering headway. Modern tractor grading outfits are not a collection of odd machines, but a co-ordinated train of machinery and economy can be secured only by exercising skill in selection, operation and maintenance. —EDITOR.

TRACTORS are used in earth moving to haul wagons and cars for transporting excavated materials and to operate excavating machines, like scrapers and graders, which are actuated by traction. The usual forms of tractor grading outfits are (1) tractors and elevating graders in which case wagons move the excavated material (2) tractors and wheel scrapers (3) tractors and blade graders and (4) tractors and special earth-moving appliances such as land levelers and bulldozers. Ordinarily, blade grader outfits are used for light grading or for finishing rough grading which has been done with elevating graders or wheel scrapers. For heavy grading, contractors east and south of Illinois favor wheel scrapers, while north and west they prefer elevating graders. The land leveler is a development of the Far West. It is a large wheel-scraper type of machine originally employed to level land for irrigation but now used generally in grading operations of other kinds. The bulldozer, a scraper blade attached to and pushed by the tractor, is a special device for grading fills. The primary function of all these combination outfits is to move earth.

A secondary use of tractors in grading is to prepare the ground for earth moving. Clearing and grubbing, and, in hard ground, plowing or scarifying, are important tractor operations. Under certain conditions these secondary uses have to be considered very carefully in selecting tractor grading equipment.

Selecting Equipment

There are certain considerations in selecting equipment which apply to all grading operations. They may be set down in the form of rules as follows:

1. Select equipment for its general serviceability. This rule applies particularly to tractors. The variety of duties, from stump-pulling to hauling empty wagons, which they have to perform requires all-around efficiency.

2. Standardize in type and make of equipment. This secures uniformity which simplifies operation and maintenance.

3. Select equipment of ample power and strength. Ability to master an occasional particularly steep or slippery or rough grade, or, without help, to do some especially hard digging, is often required.

With these general considerations in mind, the problem of tractor selection is to determine the kind of tractor and the sizes of tractors which are most efficient for earth grading. At best the hauling conditions are difficult. There are loose soil, soft ground, rough and steep roads and, often, little room for turning and maneuvering. Experience indicates that a gasoline tractor with crawler traction, best meets these conditions.

In general the gas engine has the same advantages for tractors that it has for motor trucks. Multiple cylinders give a compact high-power unit. It is self-contained in respect to fuel supply and operates equally well in all positions of the frame resulting from tilting on rough roads.

Crawler tractions, because of their large area of contact with the ground and the succession of gripping treads, give great pulling power in loose soil. Their wide distribution of the load reduces the danger of miring in soft ground. The long flexible treads ride easily over the bumps and depressions of rough excavated earth. The possibility of operating the treads separately, forward or in reverse, enables sharp, quick turns to be made. Their small vertical height keeps the center of gravity close to the ground and permits longitudinal or transverse tilting without dangerous loss of stability.

Two sizes of tractors, 25 and 40 hp., will meet the requirements of most grading operations. In grading, the small tractor—10-hp. to 12 hp.—is frequently a useful supplementary machine. It will handle a plow, one wagon, a small blade grader or a single fresno or wheel scraper. Its proper function is road conditioning and performing light earth moving where the 25-hp. tractor cannot be given full load.

Working Capacities

Manufacturers indicate the sizes of their product in different ways but horsepower, based on drawbar pull at a definite road speed, is perhaps the most simple method for the contractor. On this basis, the two sizes of tractors for heavy grading correspond approximately to 25 hp. and 40 hp. at a working speed of 3 miles per hour. The capacities of these sizes, measured in equipment operated, are about as follows:

A 25-hp. tractor will operate two or three self-loading wheel scrapers or an 8- to 10-ft. blade grader or it will haul two 3½- to 4-cu.yd. wagons. The 40-hp. tractor will operate the largest elevating grader on low gear, from 1½ to 2 miles per hour, and in some work, including casting on direct, on direct drive at 3 miles per hour. It will handle six self-loading wheel scrapers or a 12-ft. blade grader, or, sometimes, two 8-ft. graders. On low gear both sizes will handle their loads on grades up to 30 per cent. Either will make a complete turn within an ordinary roadway.

In selecting grading equipment—graders, scrapers and wagons—it is best to choose machines which are especially designed for tractor operation. Ordinarily, two or more machines are hauled in train. Therefore, special couplings, stronger draft gear and a stronger running gear as a whole, are required. Tractor operation is more intense than team operation, that is, the speed is faster and the machines are kept more steadily

at hard work. Equipment designed for team operation, and wagons particularly, ordinarily must be provided with supplemental draft gear to be safely operated, especially in train, by tractors.

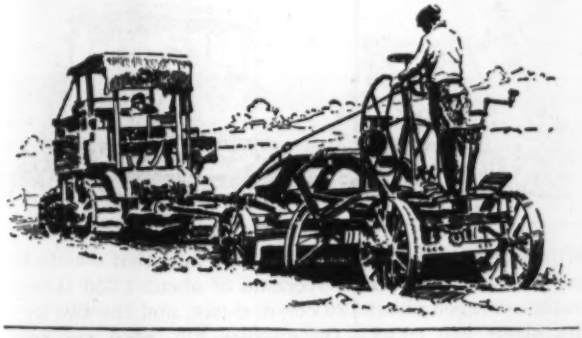
Tractor grading equipment is usually installed by the manufacturer. A service man sets up the machine and puts it in operation. With a trained operator to receive the equipment there are no difficulties in installation.

The factors chiefly to be considered in tractor operation are: Skilled operators; speed of operation, road conditioning, crew distribution, overloading and job planning.

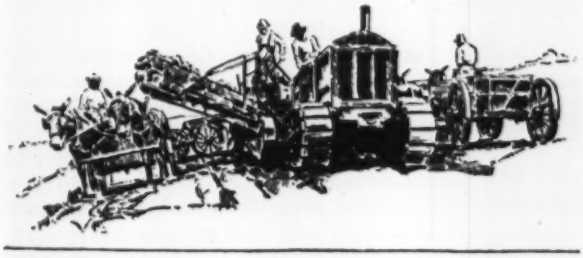
The fundamental requirement for success in operating tractors for grading is trained operators. Economy in wages should not tempt the contractor to employ untrained men. The trained driver will secure enough better service from his tractor and reduce repairs enough to make his higher wages an economy. He will do this by intelligently alternating speed and tractive power to suit the conditions, by pure skill in driving, by keeping his machine tuned up and by anticipating replacements due to wear and making them before a breakdown stops operation.

Speed of operation is a function of the working conditions. For example, if all the equipment including wagons is operated by tractors it is possible to maintain a higher normal rate of travel than where the wagons are hauled by teams. The speed naturally also varies with the character of the roads and with the loads. Tractors of the latest model are usually equipped with three speeds and optional combinations can be provided. A 40-hp. tractor has normally 1½, 3 and 5 miles per hour gear speeds but to meet special conditions a low gear of from 1½ to 2 miles and a direct drive of 2½ miles per hour are available. Older models generally had lower speeds, as 1½ miles per hour on low gear and 2 miles per hour on direct drive.

In actual operations the speeds are alternated as the load demands, as is indicated by the accompanying dynamometer graph of a typical wheel-scraper operation. In this instance a 25-hp. tractor was operating a train of three 4-wheel 1-cu.yd. scrapers in a medium damp clay soil. As indicated, the scrapers are loaded one at a time at low gear, or 1½ miles per hour. Then the tractor is shifted to direct drive, 3 miles per hour, which is maintained while the loads are hauled to the dump. With the scrapers unloaded the speed is changed to high gear, about 5 miles per hour, for the return trip. The lower line of the diagram shows the drawbar pull at all points of the haul. The time required is indicated by the upper line of the diagram. In operating other kinds of excavators, the diagram of drawbar pull will be different than that shown, but in all cases there is alternation of the speed with the load and here is where the skill of the operator assists in keeping the efficiency high.



Neglect to keep the haulageway in reasonably good condition results in loss of work and increases the wear of tractors. Crawler tractions have a surprising ability to negotiate bad roads but they exert their best power and speed on good roads. Road conditioning is, therefore, important in tractor grading operations. An occasional smoothing cut with a blade grader and particularly a skimming cut, immediately after rain, to remove the top mud, keeps the road in shape to get speed and pull from the tractor and the cost is small compared with the gain. Good road conditions cut down the road trip time. Fig. 1 shows a round trip time of about 6 min. for about a 1,000-ft. total haul. This is good time over average roads. In continuous operation the lost time factor to be added is about 15 per cent of 1½ hr. per 8-hr. day.



One man operates the tractor under all conditions. Crew distribution, therefore, becomes a real problem only in connection with the grading units, and here choice of practice is called for only in manning wheel-scraper outfits. One scraper man usually loads the train of scrapers, one scraper after another, as each arrives at the point of cut. Some operators advocate a variation of this practice. They employ a separate operator for each scraper. The advantages, they claim, are that the scrapers are kept in better running order; a larger load is taken and a more even cut is made; the time of getting ready for work in the morning is reduced; the work is more active because the men do not become so tired and there is always extra help for an emergency.

Precaution against overloading is important. On whatever speed—low, direct or high—the tractor is operated, there should always be a reasonable margin of reserve power. An advantage of having experienced operators is that they will not fail to notice when the tractor is overloaded. There are circumstances in which the returns from the work performed under overload may be thought to exceed the cost of increased wear and depreciation, but this advantage is always secured at the risk of increased danger of breakage. It is safe to assume that overloading is never really desirable.

More careful planning of the whole operation is required in tractor grading, because all units work faster than in team grading and commonly they work in trains. This calls for more accurate scheduling of movements to prevent interference, particularly if several excavating units are distributing onto the same fill. There should be closer co-ordination of both equipment units and operating processes because interruptions of full output are more costly. Better living and working conditions are required to hold the trained operators who replace the teamsters and roustabouts of a team outfit.

On the other hand, the crews, and the accommodations and supplies for teams, are reduced, and generally the job housing and living problem is simplified.

Maintenance begins with the careful inspection of the tractor when it is received. *Inspection thereafter should be made at stated intervals as daily, weekly and monthly.* These inspections have two purposes, one is to determine the condition of the machine in respect to wear and needed replacement and the other is to perform the work required periodically to keep it in good operating condition. It is in this periodical inspection and constant maintenance that the trained operator demonstrates his value. With an outfit of five to seven tractors a high class mechanic, in addition to the operator, is a profitable investment.

Special provisions for making major repairs, beyond replacements, are not necessary except possibly in isolated or very large plant operations. Ordinarily also, a large stock of spare parts is not necessary. Large manufacturers of tractors and grading equipment provide service stations at most centers of tractor operations from which replacement parts can be secured in a short time and good maintenance inspection can anticipate needed renewals in ample time to have the parts on hand. Standardized equipment considerably simplifies the problem of replacements.

Depreciation and Plant Requirements

Different contractors use different methods of estimating the working life of a tractor and for computing its depreciation. Much depends upon the character of the work, the character of the operation and maintenance, and contingencies which can be classified as pure accidents. Tractors are better built now than ever before, and based upon the performance of earlier built machines, it is safe to assume that a 40-hp. tractor will have a life of 1,000 working days, and at the end of that time, through reasonable care and prompt replacements, the tractor will still be capable of some further service.

Grading equipment, ordinarily assumed to have a depreciation of from 20 to 33⅓ per cent, will have a greater depreciation if operated by tractors. Manufacturers of road machinery are, however, constantly strengthening their equipment to meet the extra demands of tractor operation and this, of course, means longer life and less depreciation as time goes on.

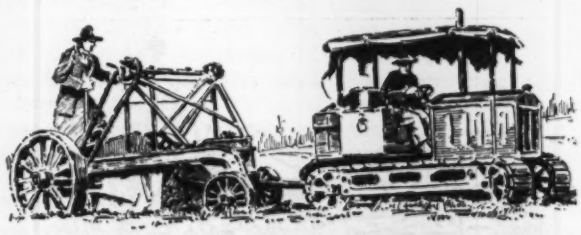
The plant required for a tractor grading job depends upon the volume and character of the materials; the depth and relative locations of cuts and fills; the length of haul, and the period allowed for completion. General directions involve so many qualifications that they are of little service. Two examples of actual operations, both well outfitted as the performances obtained have demonstrated, are therefore presented. One is a mixed team and tractor road grading operation and one is a completely motorized heavy land grading operation. Neither represents the ultimate development in tractor grading, nor the most completely equipped operation, but both represent reasonably good practice and performance.

Wheel Scraper Outfit.—On a five-mile road grading job in Kentucky the contract called for 35,000 cu.yd. of earthwork, twenty concrete culverts and 2½ acres of clearing and grubbing. The route winds among hills with few level stretches and with grades of from 2 to 6 per cent. The soil is limestone clay free from rocks. The free haul is 500 ft. with an overhaul of about 13,000 ft. on 5,000 cu.yd. A combined team and tractor outfit was selected as being most flexible, the teams and slip scrapers being used on short hauls and tractors and 4-wheel scrapers on hauls of 150 ft. and greater. Table I lists the equipment and organization.

The power units consist of two 25-hp. tractors hauling two scrapers each. Six men are employed as operators; two on the tractors and one on each of the four scrapers. On hauls of around 600 ft. one power outfit loads at 360 ft. and the other at 660 ft. from the fill, to prevent delays. On longer hauls this is unnecessary. The road is about 24 ft. wide, which gives ample room for passing at any point and the tractors turn the scrapers easily within this radius, and when necessary can turn within 18 or 20 ft. The teams, besides being used for short hauls, are found particularly useful in smoothing out the road ahead of the wheel scrapers.

TABLE I—EQUIPMENT AND ORGANIZATION FOR TRACTOR GRADING ON HIGHWAY CONSTRUCTION

Equipment	Organization
2 5-ton tractors	1 contractor
1 plow	2 tractor operators
4 four-wheel scrapers	4 scraper operators
1 8-ft. blade grader	4 mule team drivers with teams
4 No. 2 slip scrapers	1 dump man
1 Dodge touring car	1 roustabout
1 motor truck	1 man for clearing right-of-way
1 concrete mixer (1 bag)	1 loader (for teams)
75 ft. of ¾ in. chain, small tools	1 truck driver
	1 concrete mixer foreman
	5 laborers on mixer



Working up and down a 6 per cent grade that was to be cut to 5 per cent, on an overhaul of about 1,300 ft. one outfit averaged about 120 cu.yd. a day, and the two outfits about 240 cu.yd. On another hill, of 5 per cent grade, around 200 cu.yd. was averaged with each outfit, on a 600-ft. haul, and both outfits gave 400 cu.yd. per 10-hr. day.

Elevating Grader Outfit.—Table II gives the tractor-elevating grader performance and cost for a period of nine days on a land development operation requiring heavy grading for streets. This record indicates (1) with a 40-hp. tractor hauling the largest size elevating grader, the maximum volume of dirt can be cut per day even if the work is on steep grades; (2) with several 25-hp. tractors each hauling two 3½- or 4-yd. dump wagons, the maximum output of the grader can be

TABLE II—TRACTOR ELEVATING GRADER COST AND PERFORMANCE ON A LAND GRADING JOB

	Quantities			Costs Total	Costs Per Yd.
Total yards dirt removed	7,595				
Distance hauled—ft.	1,600				
Distance hauled—miles	.303				
Total yards—miles	2,300				
Total hours on field	79	15%			
Total hours actually worked	63				
Yards per hour on field	96.2				
Yards per hr. actual working time	120				
Yards—miles per hr. on field	2.91				
Yards—miles per hr. actual working time	3.65				
Gal. gasoline for hauling	945	@	.25 per gal	$236.25	$.0310
Gal. gasoline on elevating grader	334			83.50	.0110
Total gas used	1,279			319.75	.0420
Motor oil for hauling	18	@	1.10 per gal.	19.80	.0026
Motor oil for grader	16			17.60	.0023
Motor oil for total	34			37.40	.0049
Trans. oil for hauling	6.75			7.43	.0010
Trans. oil for grader	4			4.40	.0006
Trans oil total	10.75			11.83	.0016
Grease used for hauling—lb.	158	@	.10 per lb.	15.80	.0021
Grease used for grader—lb.	70			7.00	.0009
Grease used, total	228			22.80	.0030
Hauling operators	4	@	$35 per wk.	210.00	.0276
Grader tractor operator	1	@	35 per wk.	52.50	.0068
Dump	1	@	35 per wk.	52.50	.0068
Dump men	5	@	3.75 per day	169.00	.0222
Foreman	1	@	40.00 per wk.	60.00	.0079
Wagon repair man	1	@	35.00 per wk.	52.50	.0068
Grader operator	1	@	4.00 per day	36.00	.0047
Grader operator helper	1	@	3.75 per day	33.75	.0045
Freight one way*				350.00	.0460
Ford car*	1 rented	@	14c. per mi.	175.00	.0231
Camp*	1 rented tent			150.00	.0198
Board	15	@	$1 per day	135.00	.0178
Depreciation for 9 days on 1—10 tractor @ 25% per annum based on 200 working days per year				73.50	.0097
Depreciation for 9 days on five-ton tractors @ 25% per annum based on 200 working days per year				240.00	.0316
Depreciation on grader at $1,900 cost price @ 20% per annum				17.00	.0022
Interest for 9 days on investment of $25,400 @ 8% per annum				50.00	.0066
Total cost				$2,247.78	$.295
Hauling cost only				$1,450.78	$.1920
Elevating grader costs				$632.50	$.083

* The propriety of these charges is doubtful—the camp and Ford car are exhibition expenses and the total freight should not be charged against nine days' operation.

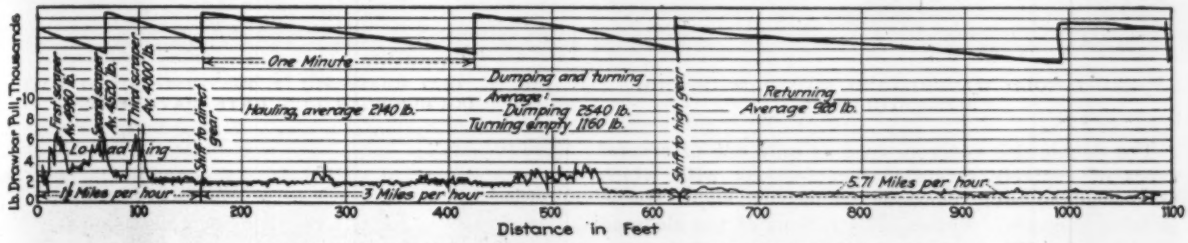
Report on Large Power Development at Umatilla Rapids

WITH the aid of the states of Washington and Oregon, the Umatilla Rapids Power Site Association of Pendleton, Ore., has recently completed a preliminary report on the plan to develop a large block of power on the Columbia River at Umatilla Rapids, 180 miles east of Portland, Ore. The report was made by the engineering firm of Lewis & Clark, Portland. Some of the chief features of the report are summarized in the following paragraphs:

Both rail and water transportation are available at the site which is within 200 miles of all the principal cities of the Northwest. Markets for the power nearer at hand are suggested in (1) the 270,000 acres of arid land within 45 miles of the site which could be irrigated by pumping, (2) the manufacture of nitrates and phosphates for use as fertilizer and (3) railway electrification.

If private capital cannot be interested in the project before the passage by Congress of the McNary bill, it is hoped that when the bill has been passed, the U. S. Reclamation Service will undertake the Umatilla Rapids development.

Foundation conditions are believed to be satisfactory. At low water bedrock is exposed or is visible for the entire length of the proposed dam except in a narrow section which is approximately 30 ft. deep. It is proposed to construct a 30-ft. dam with an open spillway 1,800 ft. long and a closed spillway 1,400 ft. in length controlled by removable gates, the structure to develop a head of 27 to 33 ft. at all stages of the river. 125,000



GRAPH OF DRAW-BAR PULL OF 25-HP. TRACTOR OPERATING THREE FOUR-WHEEL SCRAPERS

moved; (3) that tractors can handle the wagons on the dump, spreading the dirt evenly and making a perfect fill; (4) that a bulldozer attachment consisting of a stout 7-ft. blade mounted on the front end of the 25-hp. tractor reduces time and labor on the dump and in filling in around bridges, culverts, etc., and (5) with a completely motorized outfit, no teams are necessary, the labor of many men is saved, and a volume of work is accomplished which is beyond the capacity of teams.

Train Ferry for the English Channel

A train ferry service between England and France, which was established during the war to facilitate transportation by eliminating the transhipment of freight on each side of the channel, is to be started again for freight service, especially for fruit and vegetables from southern France. Box cars loaded at different points are to be assembled in trains which will run to Calais, the train ferry conveying them to Richborough, where they will be landed and forwarded by rail to London.

continuous horsepower could be developed at low water, 300,000 hp. for eleven months of the year and a total of 500,000 hp. during the irrigation season, the larger power during the irrigation season making it possible to carry the irrigation load without interfering with the sale of power which would be developed for continuous industrial uses.

The cost estimates allow $9,000,000 for the dam, navigation locks, railway relocation, overflowed lands, etc. In addition to that the power development costs would range from about $16,000,000 for 180,000 hp. to $32,000,000 for 500,000 hp. On the basis of construction by the U. S. Reclamation Service with interest at 5 per cent and operating without direct profit the annual cost per horsepower at the switchboard, including all fixed and operating charges, is estimated to be, on the basis of a 300,000 hp. development, $11.40 for primary power, and $6.85 for secondary power. The power cost would be slightly less on the larger power development plan and somewhat more under the minimum development plan.

New York Develops Double-Slab Concrete Roads

Parallel Concrete Slabs Separated by Macadam Give Three-Way Road at Cost of Single Two-Way Slab

RECENT reconstruction of waterbound macadam roads in New York has developed a double-slab concrete road section which automobile and truck drivers are greeting with favor. It is also proving to be a section which stands up under traffic without excessive maintenance charges on the macadam strip which separates the two concrete slabs. In regard to cost, a 24-ft. paved highway is being secured at about the price of a 20-ft. single-slab concrete road. Inspection of a number of sections from Rochester east to Albany and south to Poughkeepsie disclosed in every instance an easy riding road of handsome appearance.

FIG. 1. OLD WATERBOUND MACADAM BEFORE RECONSTRUCTION

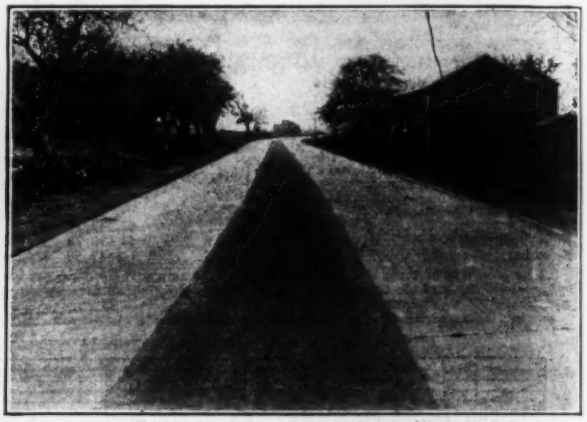


FIG. 2. OLD ROAD, FIG. 1, RECONSTRUCTED WITH DOUBLE-SLAB CONCRETE PAVEMENT

The double-slab concrete road is only one of several types of concrete reconstruction sections with which old macadam, badly damaged by modern motor traffic, is being replaced. Typical illustrations of the old road conditions and the reconstructed highway are given by Figs. 1 and 2. This particular road is near Albany. The cross-section and reinforcement details shown by Fig. 4 are those of a road south of Rhinebeck, N. Y. Examination of this section, with a statement of the modifications employed on other roads, will give a clear idea of the double-slab practice being followed.

In the section shown by Fig. 4, the old macadam is excavated rather deeply and out to the ditch edges. The center strip of macadam is new construction in its entirety. It is 6 ft. wide and the side slabs are 9 ft. wide; these widths are now standard, but some of the older improvements have 8-ft. and 8½-ft. concrete slabs which have proved somewhat too narrow.

Returning to the excavation, the fact to be remembered is that the operation is always one of reconstruction, and to provide an emplacement for the concrete slabs and to build up the separating macadam are different problems in nearly every case. Where the old macadam is narrow, the sub-base has to be extended with new broken stone or slag. Often the concrete slabs are placed virtually on top of the old road, which is merely scarified and the sharp crown flattened by shifting the excess material to the edges. In other instances, emplacements for the slabs are excavated and the center strip is left undisturbed and is merely surfaced with macadam.

The concrete slabs are invariably reinforced, but practice in designing reinforcement varies somewhat with the preferences of the different division engineers. Two broad types, mesh reinforcement and bar reinforcement, are employed and the general character of each is fairly indicated by Fig. 4. Practice in mesh reinforcing ranges from 32 lb. to 60 lb. per square. When bar reinforcement is employed it seldom is lighter than 60 lb. A distinctive feature of this reinforcement is the bent bars placed at the four corners of each 33-ft. slab. These are ½ or ⅝ in. bars 8 or 10 ft. long bent at a 90° angle at the center and laid directly on the wires or bars.

To keep a way open for traffic, one slab at a time is constructed. This is required by the specifications. No more than one half of the road can be obstructed

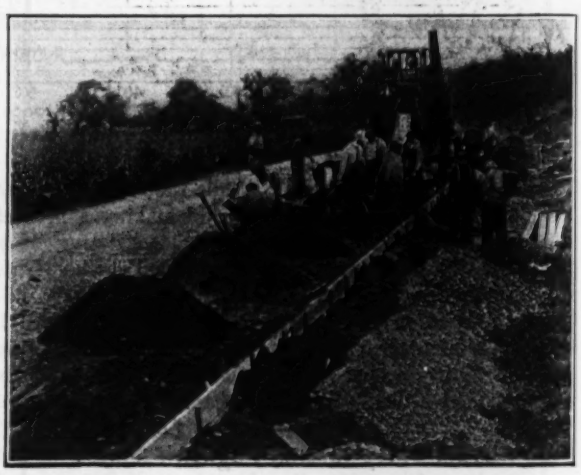


FIG. 3. CONSTRUCTION OUTFIT FOR DOUBLE-SLAB CONCRETE ROAD

by plant or operations. Ordinarily the full width is scarified and regraded; then one slab is built; then the second slab and finally the center strip of macadam. A typical construction outfit is shown by Fig. 3. On work inspected near Rochester, N. Y., a slab 8½ ft. wide, 6 in. and 8½ in. thick, was being completed at an average rate of 450 ft. a day with a gang of 18 to 20 men, charging with wheelbarrows and finishing with strikeboard,

roller and belt. The bidding price for 0.8 miles was $22,600, or $28,250 a mile. In another division the bidding price for 1¼ miles of 9 — 6 — 9 ft. road was $54,000 or $36,000 a mile.

Recapitulated briefly, the advantages of the double-slab design are: It leaves one half of the road clear for traffic during construction; it gives a wide hard road at no greater cost than a narrower single slab design; it provides distinct routes for right and left traffic and thus contributes toward safety of travel; it is smooth riding and attractive in appearance. It's disadvantages are that the narrow slabs concentrate wear and the penetration macadam separating strip requires considerable maintenance.

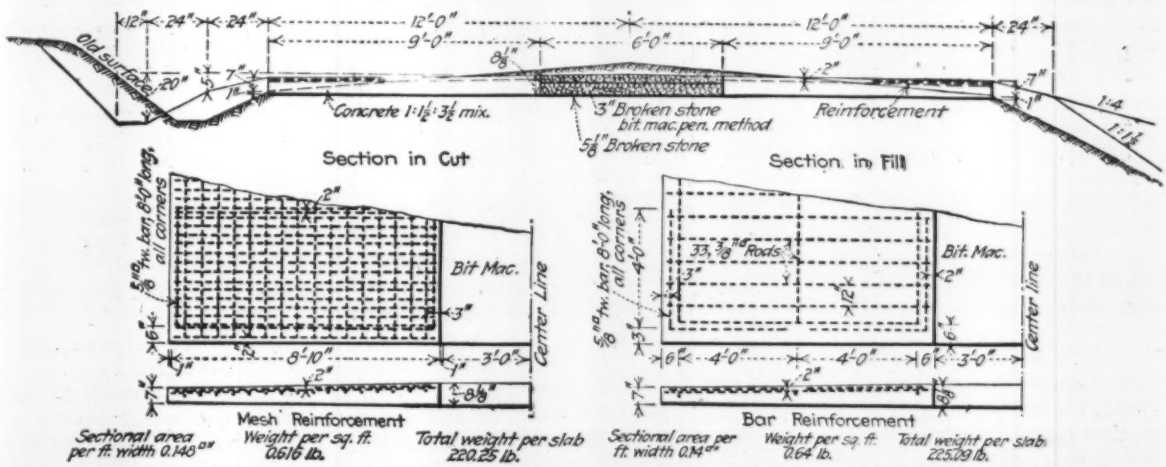


FIG. 4. CROSS-SECTION AND REINFORCEMENT DETAILS OF DOUBLE-SLAB CONCRETE ROAD

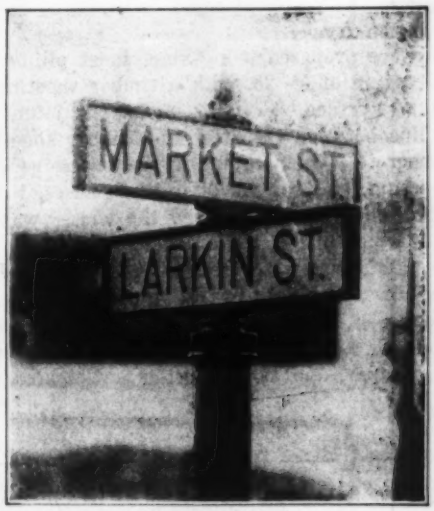
St. Louis Suburban and Rapid Transit Plans

A downtown suburban terminal station for steam railways at St. Louis, Mo., and a combined elevated and subway rapid-transit line for street and interurban electric cars have been proposed by the Department of Public Utilities in order to meet the needs of suburban and local traffic. The union station is distant from the business district and the report states that its main-line traffic is so heavy as to cause suburban trains to be held outside frequently for 10 or 15 minutes before tracks are available. A 16-track station at the southeast corner of Market and Twelfth Sts. is proposed, having its floor 17 ft. below street level. Increased suburban train service is recommended, as well as a belt line service around the city and connection with East St. Louis, as the heavy traffic with the latter city is now accommodated mainly by street and interurban electric lines.

For the rapid transit electric service it is proposed that the Hodiamont line, which has a private right-of-way, should be elevated on a solid fill between concrete retaining walls from Maple Ave. to Spring Ave. At the latter point the line would pass into a subway ending in a loop under Lucas, Morgan and Sixth streets and Broadway. Both suburban and interurban lines could use this route, the interurban cars making only few stops. These improvements in local traffic accommodation are outlined in a report by James A. Hooke, director, and Charles S. Butts, engineer, of the Department of Public Utilities.

New Street Signs for San Francisco Cost $18 in Place

SAN FRANCISCO has adopted a new standard street sign, installation of which is to begin at once. The first signs are being put in in the downtown section and the work is to be continued toward the outlying districts. The type selected, as shown in the accompanying picture, consists of two metal plates set at right angles and fixed to a 3-in. standard pipe support 9 ft. above ground. The bottom of the pipe is imbedded in concrete foundation, and is set 30 to 36 in. back from the face of the curb on the extension of the property line. The first installation will consist of one sign



NEW SAN FRANCISCO STREET SIGN

on each street intersection. Later a second sign on the corner diagonally across, is to be added.

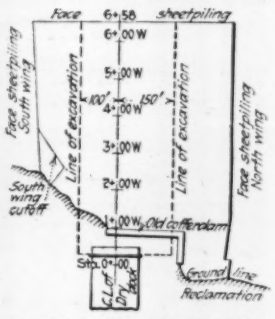
The name plates are 5 x 22 in., made of 16 gage galvanized iron with 3-in. letters milled in the plate. The plates are surrounded by ¼ x 1-in. iron channels. Both plates and frames are finished in baked enamel, the lettering and border being of a dark blue color and the background lemon yellow. Posts are painted black 6 ft. from the ground and the remainder of the post is yellow to match the frames. The cost of each sign erected and painted is approximately $18.

Building a Sheet Pile Cofferdam in a 28-ft. Tide

Trestle With Timber Sheeting Used in Construction of Courtney Bay Dry Dock at St. John, New Brunswick

BY H. E. HUESTIS
Engineer, Quebec, Canada

IN CONNECTION with the 1,150-ft. dry dock being constructed at Courtney Bay, St. John, New Brunswick, under the direction of the St. John Dry Dock & Ship Building Co., it was necessary to excavate an entrance channel 250 ft. wide and approximately 500 ft. long, or to such a distance from the return walls of the dock as to remove all rock to an elevation of — 32, or 32 ft. below low water. There is a tide of nearly 30 ft. here so the cofferdam offered considerable difficulty.

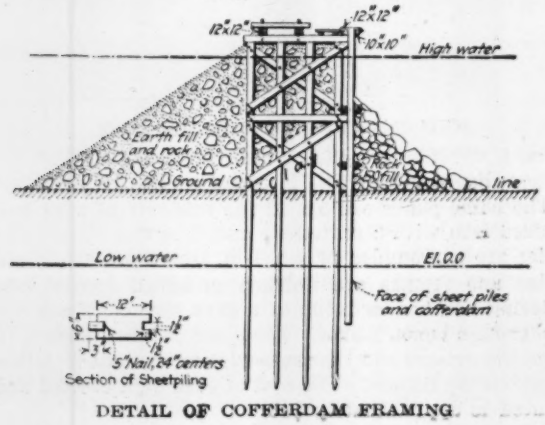


PLAN SHOWING COFFERDAM FOR COURTNEY BAY DRY DOCK

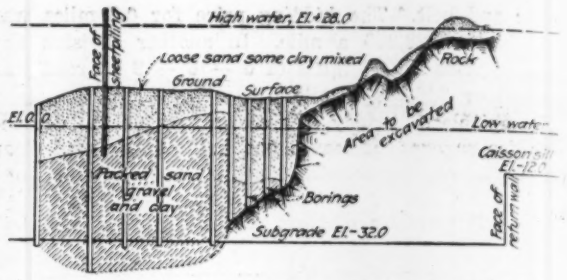
The Bedford Construction Co., at the time, July, 1919, were excavating the prism of the dock, and associated with James B. Craven, New York, took a further contract to remove the material in the entrance channel. This material was estimated to be 140,000 cu.yd. of rock and 110,000 cu.yd. of overlying sand, clay, etc., and as the excavation was a continuation of the dock, seaward or westerly, although at a 12-ft. lower level, it was decided that by the erection of a cofferdam, the material could be removed by steam shovels in the dry.

Plans were prepared using steel sheet piling driven to an elevation of — 33, with a timber sheeting from the ground surface, + 10 to + 32, the joint, at the ground line between the steel and timber sheeting, to be of concrete. On account of the excessive cost of steel sheeting, and for various other causes, this plan was not deemed practicable and the writer was asked to submit other plans.

Two sets of plans were prepared and submitted. One consisted of a double row of timber sheeting, with puddle between, and the other, a single sheeting driven on the outside face of a trestle. As the latter was some $70,000 cheaper, and as the writer anticipated no appreciable leakage from the ground surface to high-water mark, the company decided on the cheaper one.



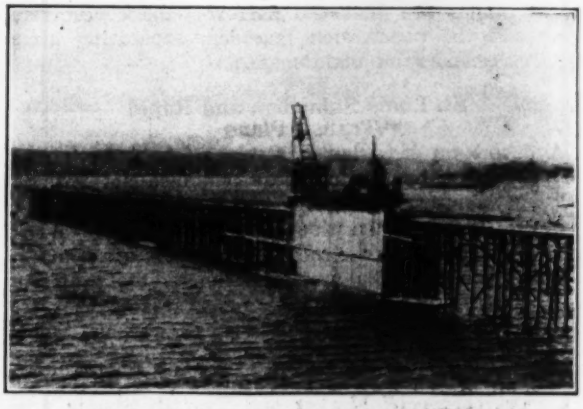
DETAIL OF COFFERDAM FRAMING



SECTION SHOWING MATERIAL OVERLYING ROCK

A most complete set of borings, every 25 ft. over the whole area and to a distance of 900 ft. west from the dock return walls, taken by the Department of Public Works, showed a stratum of clay varying from 5 to 15 ft., overlying and practically following the dip of the rock and although loose sand and gravel was shown underneath this clay stratum, yet at Sta. 9 + 00 west the clay bed dipped to El. — 33.

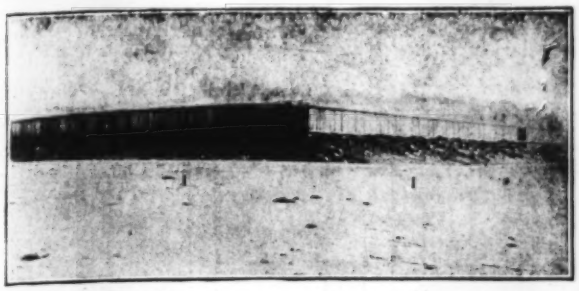
Due to this condition, the writer believed that it would not be necessary to drive sheeting to El. — 32, the level to which the rock should be excavated, but that timber sheeting driven to just penetrate but not pierce the clay bed, and the exercising of the company's right, by a clause in their contract, whereby the dredges could not work within Sta. 12 + 00, would thus keep the clay stratum unbroken, and acting as an impervious blanket, permit steam shovels to take out the material in the dry. The actual conditions worked out as anticipated.



TRESTLE CONSTRUCTED; DRIVING SHEETING ON FACE

The maximum high water at Courtney Bay is + 28.4 the average being + 24, and as the ground surface elevation of the entrance channel is about + 10, twice a day this flat is dry, which facilitated both the erection of the cofferdam and the subsequent dewatering and pumping.

A four pile driven trestle, bents 10 ft. c. to c. was erected, at an average distance of 150 ft. outside the area to be excavated, to which were bolted three double rows of 10 x 10 wales, between which was driven 6 x 10, 12 and 14-in. tongue and grooved British Columbia fir, in lengths varying from 34 to 44 ft. To save timber, which costs from $65 to $85 per thousand ft. b.m., each piece had two grooves, 1½ x 1½ in., and before



NORTHWEST CORNER AT LOW WATER, SHOWING OPENING AT RIGHT

driving, a splice 3 x 1½ in. was nailed in one groove, thus forming the tongue.

Each sheet pile was pointed at the end, and by means of a screw jack, clamped to a pair of wales, it was forced into its companion tongue. Driven by a steam pile hammer to the desired distance, this gave a practically watertight joint. The average penetration was 16 ft., the cutoff being made at El. + 32, which was considered high enough to take care of waves or wind spray.

The work on the trestle was commenced in August, 1919, and sheeting completed at the end of the following November. Previous to the completion, an opening 20 ft. wide was made in the face, to take care of the rise and fall of tide, and before closure a 15-in. pipe and valve were installed, to let out at low water any water that might make during tides.

To add to the stability of the cofferdam, material was dumped inside and outside the face of the sheeting. Clay was to be used, but having in view the experience of the Boston cofferdam, clay was first tried out on the approach trestle, with the result that with the rise and fall of the tide, the clay sloughed to such an extent, that full bents were carried away. Clay was accordingly dumped around the toe only, and the balance of the fill was made up with rock and overburden. In all some 35,000 cu.yd. of rock and 42,000 cu.yd. of clay and overburden were placed around the cofferdam.

Closure was made at the end of December, and with the exception of the southeast corner, where loose rock was struck, the cofferdam was a complete success.

As there was no immediate need of the cofferdam during the winter months, owing to the fact that the 15-in. pipe, assisted at times by an 8-in. pump, could cope with all leakage, nothing further was done until June, 1920.

In the meantime it was learned that the loose rock at the southeast corner was the result of an exhibition shot, touched off by the Honorable Minister of Public Works, at the inauguration of the St. John dry dock, some years previous. It was shot but never moved, and being afterwards filled in, gave no indication of what was actually struck. Exhibition shots are "no bon."

In June by finding solid rock in the southeast corner, and trenching to follow it, a cutoff was built and apart from some water which still came in at high water, no further trouble was experienced. An 8-in. pump working from 8 to 12 hours a day took care of all the water both on the ground surface level and the level of the pit excavation.

INSIDE VIEW BEFORE EXCAVATION COMMENCED

The first big shot in the submarine area was May 12 and by December, 1920, some 125,000 cu.yd. of rock and 80,000 cu.yd. of overlying material had been removed. It was quite feasible to remove the balance, but as the St. John Dry Dock Co. had not completed all preparations for the construction of their caisson, as an extra precaution it was mutually agreed that this material should be left. At the present time these caisson walls are being constructed by the St. John Dry Dock Co. and it is to be hoped that they will be expeditiously carried out, as the cofferdam was not intended for more than two seasons.

The conditions at Courtney Bay were unique in their way, inasmuch as steam shovels were excavating below the

INSIDE THE COFFERDAM: SHOVELS WORKING AT EL.-32

bottom of the sheeting, or under an extreme head of 62 ft., at high water, and this stratum of clay acted in every sense as a lower level cofferdam. There was absolutely no indication of water coming in at the face of the cut.

In addition to acting as a cofferdam, the trestle was used as a means of receiving all freight and coal, and also as an approach to a dump for the shipways embankment, over 200,000 cu.yd. of material from the prism of the dock being carried over it.

The total cost of material, construction and maintenance of the cofferdam, during excavation, was a little over $1 per cu.yd. of submarine rock removed.

Locomotive Track Scale Shows Load on Each Wheel

Platform of 450-Ton Scale Carries Portable 25-Ton Scales Which Register Weight on Individual Wheels

By Carl C. Bailey
Baldwin Locomotive Works, Philadelphia, Pa.

A NEW LOCOMOTIVE weighing plant of high load capacity at the Baldwin Locomotive Works, Eddystone, Pa., has the special feature of a scale platform wide enough to carry portable scales for taking the load on each individual wheel. The large scale is composed of six sections, each designed for a theoretical concentrated load of 150 tons, making a total of 900 tons, with a working capacity of 450 tons. Fig. 1 shows an engine on the scale platform, with the individual scales adjusted to its wheels. Fig. 2 is a cross-section of the plant.

Weighing locomotives at the Baldwin works has been done hitherto by taking the total weight on a track

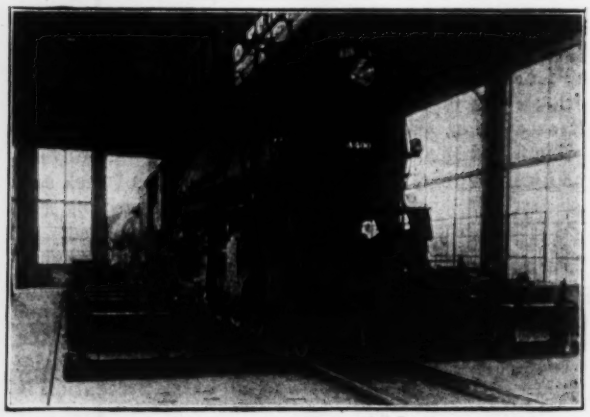


FIG. 1. LOCOMOTIVE ON TRACK SCALE WITH INDIVIDUAL SCALES UNDER THE WHEELS

scale and then moving the engine to a track having concrete foundations wide enough to allow of placing an individual scale under each wheel. It was difficult, however, to obtain any degree of accuracy in comparing the total weight on the platform with the sum of the weights of the individual scales. After investigations as to the weight of the largest locomotive which it would be practical to build, it was decided to construct a scale of 450 tons working capacity and with a platform of such width as to permit placing individual scales under the wheels. In this way all weights would be determined with the engine in one position.

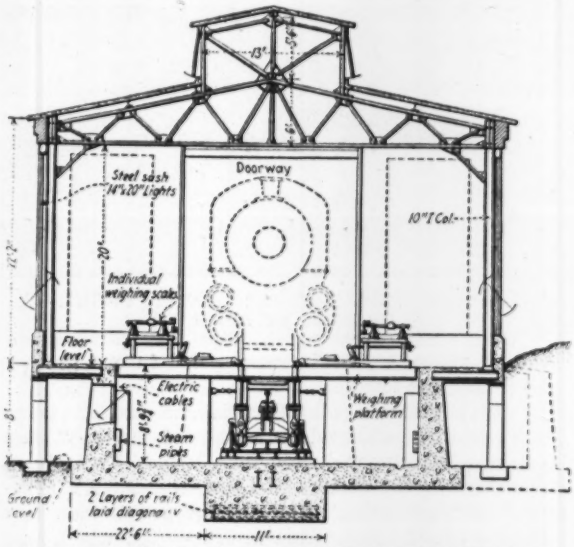


FIG. 2. SECTION OF LOCOMOTIVE WEIGHING PLANT

At the new plant, the scale platform is 100 x 27½ ft., and the 110-ft. pit is extended 5 ft. under the floor at each end. This end arrangement is to enable the load to pass over the main bearing pivots of the end section before it rests on the scale proper, thus alleviating the impact on the knife edges, increasing the life of the mechanism and resulting in more accurate weight. The design and arrangement of parts are shown in Fig. 3.

In considering the stresses recommended by the scale specifications of the American Railway Association and the U. S. Bureau of Standards, it was found that under maximum loading the longer extension levers, if designed by the given fiber stresses for the tension side in transverse bending, would deflect much more than permissible for this class of work. By designing the longer levers with regard to deflection as well as fiber stress, these latter stresses were much reduced. To conform to these specifications, the designers were confronted with the problems of producing a knife edge in the main levers which would be of sufficient length to take a loading not to exceed 7,000 lb. per lineal inch, and of supporting it in a substantial manner to secure an even distribution of the load.

These knife edges, 22 in. long, are made of a special oil-hardened alloy steel which has an elastic limit of not less than 160,000 lb. and a tensile strength of not less than 200,000 lb. All other knife edges and bearing steel meet the same requirements. The entire surfaces of all pivots and bearings are machined, hardened and ground and set in machined ways. Bearing steels for fulcrum stands are set in removable blocks. The knife edges are so constructed as to have continuous contact with their bearings and the only bow loops are those for counter-balancing or back-balancing the weigh beam.

Each of the twelve cast steel main levers weighs approximately 1,075 lb. and has one end resting upon a fulcrum stand, the other end being suspended by a stirrup. From these levers the massive cast steel yokes that carry the platform are suspended by two heavy machine steel stirrups, as shown by Fig. 3. The bedplate supporting the main and the extension lever fulcrum stands is a single casting secured to the foundation by independent anchor bolts in order to facilitate accuracy in leveling up on a concrete foundation. There

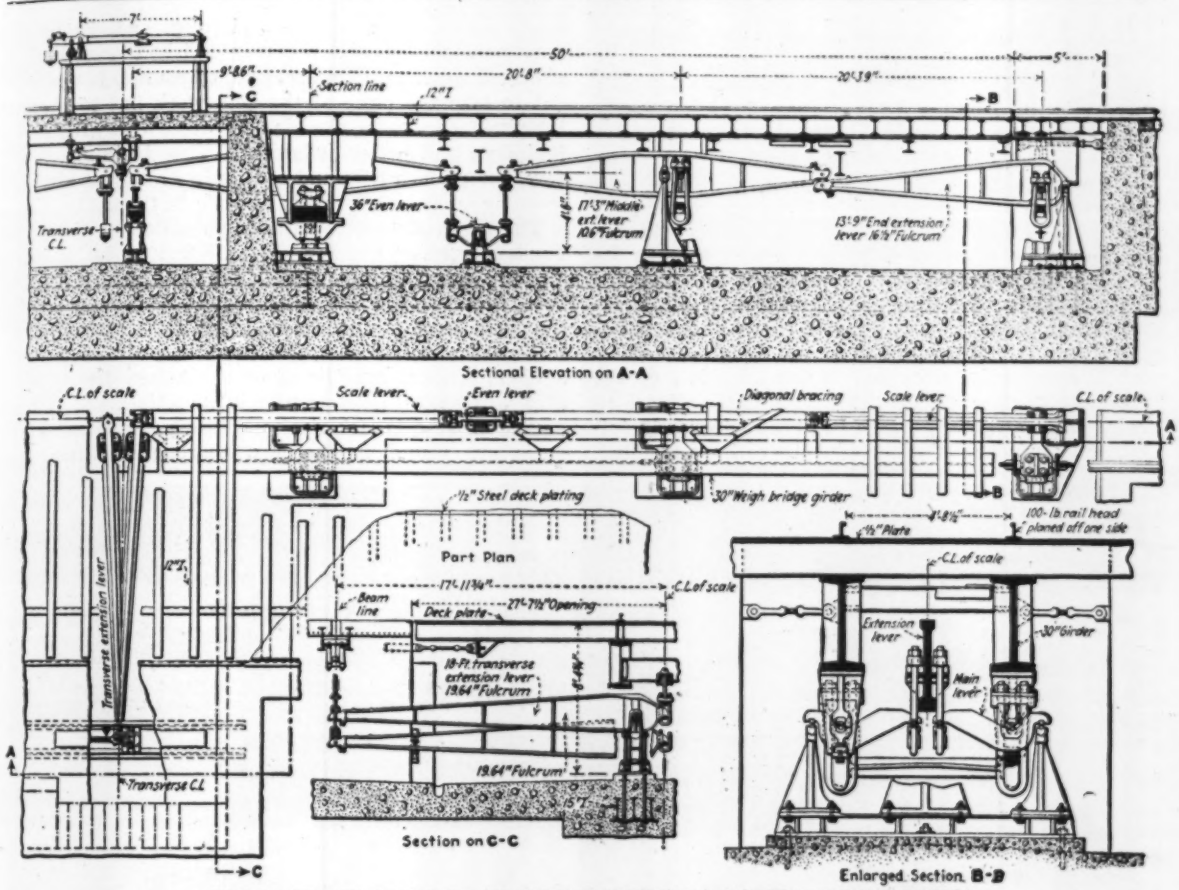


FIG. 3. TRACK SCALE OF 450-TONS WORKING CAPACITY (900 TONS TOTAL)

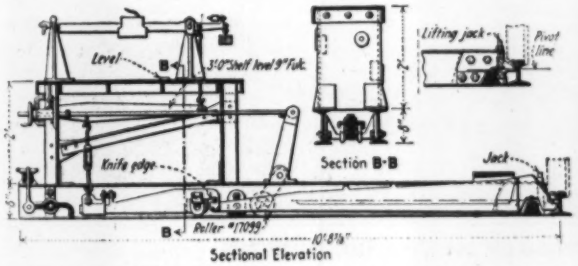


FIG. 4. PORTABLE SCALE FOR TAKING LOADS ON INDIVIDUAL WHEELS

are ten bedplates; one for each scale section, two for the even levers that connect the inner sections and two for the transverse extension levers. These last four are of cast steel because the stress is practically direct tension. All contact points of metal against metal are machine finished.

The connection between the middle extension lever and the transverse extension, shown in Fig. 3, is accomplished by means of two machine steel stirrups passing over bearing blocks which engage the butt pivot of the transverse lever and the end pivot of the middle extension lever. These stirrups are then connected by a 2-in. plate which permits vertical adjustment. The connection between the middle extension lever and the 3-ft. even lever consists of two similar stirrups that pass over the bearing blocks which engage the end pivot of the middle extension lever and the end pivot of the even lever. These stirrups are connected by two 1¼-in. plates and two draw bars. To resist the upward pull, the fulcrums of the even levers and extension levers are anchored to the sub-bases by cast-steel inverted stirrups, each held by two 1¼-in. anchor bolts. In the upper part of these stirrups are bearing blocks engaging the fulcrum knife edges.

The connection between the transverse extension lever and the lever under the weigh beam is arranged to permit one lever to be leveled independent of the other, to allow swiveling to match the different angles at which the levers hang and to give vertical adjustment to the levers in unison. In design and manufacture, great care was exercised in locating all pivots practically on the neutral axis of the section, in order to obtain an even distribution of the weights about the pivot line. On the platform scale the weigh beam is graduated by 5,000-lb. increments to 895,000 lb., an auxiliary beam of 5,000 lb. capacity graduated to 50-lb. increments brings up the total capacity to 900,000 lb.

New 785-Mile Trip is Longest Train Run in Britain

The longest British railway run is the new 785-mile 22-hour trip between Penzance at the southwest corner of England and Aberdeen on the northeast coast of Scotland. Through day cars are run, dining cars are attached at convenient times and sleeping cars are attached in the evening. The route is over six different lines and serves a number of important cities. This service is operated daily in each direction.

Sand Box Employed in Teaching Topographic Mapping

University of Illinois Adopts Plan Which Clearly Indicates to Student Interdependence of Various Steps Taken

By W. H. Rayner and J. R. Stubbins
Assistant Professor of Surveying, Instructor in Surveying
University of Illinois

ONE of the greatest difficulties which attends instruction in topographic surveying is to secure the proper conception in the student's mind of the interdependence of the various steps to be taken in the execution of such a survey. It was primarily an attempt to meet this difficulty which led to the adoption, at the University of Illinois, of the device to be described herein. This original purpose has been adequately fulfilled, and a number of other advantages have resulted.

The use of models for instructional purposes and for studying layout schemes of various sorts is common practice and the value of this aid to instruction was fully demonstrated in the late war. Much use was made of the sand-box, the puff-board, and the relief map in the different branches of the service. It is believed, however, that the application of the use of the sand-box to instruction in the design and execution of accurate topographical surveys is new and of peculiar value.

The general features of the scheme may be stated briefly as follows: A landscape which includes the more common topographical features is modeled accurately to scale in the sand-box; a set of field notes for a complete transit-stadia survey of this area, is derived from the sand-box landscape by methods to be explained later; the students are then assembled around the box and each man acts as the recorder of a transit-stadia survey party. The instructor acts as the instrument man, calls off the notes just as they would be called off by a transitman in the field. By proper methods the students reduce these notes for plotting, and, finally the survey is plotted and the map finished according to standard practice. This scheme, of course, is designed not to take the place of the field work but to prepare the student to undertake his field work with greater intelligence and better judgment. This training, therefore, saves much time and results in greatly accelerated learning on the student's part while in the field.

The materials used in the construction of the sand-box landscape are: 1 box, 6 ft. x 8 ft. x 10 in.; ¾ cu.yd. of fine sand; 2 cu.ft. of pulverized shale; 2 sets of symbols for houses, water-tanks, bridges, etc., secured from the U. S. Disciplinary Barracks at Fort Leavenworth, Kan.; sponges for trees, and other symbols as desired.

Some practice may be necessary before the uninitiated will secure good results in modeling, but a high degree of skill is not at all necessary. The sand and shale are placed in the box, thoroughly mixed and moistened. The sand will remain moist for two or three days but all modeling should be done on the first day. The model is constructed according to the general plan selected, care being taken to keep the features and shapes consistent with the scales chosen. It has been found desirable to double the vertical scale so as to give a more impressionistic view of the relief. Perhaps the trees, houses and bridges will not be exactly to scale, but the impression will be very good nevertheless. A good effect for underbrush may be secured by dropping lumps of wet sand on the finished surface. Pieces of sponge stained green make good tree symbols and light-brown plasticene strips may be used for roads, etc. Any degree of elaboration may be used in the embellishment of the model. A view of the box as now in use at the University of Illinois is shown in Fig. 1.

FIG. 1. SAND-BOX GIVES VIVID PICTURE OF TOPOGRAPHIC FEATURES

From this point the procedure is as follows: The instructor chooses a purpose for the survey of this area, and for the survey here described it is assumed that a transit tape traverse is best for the horizontal

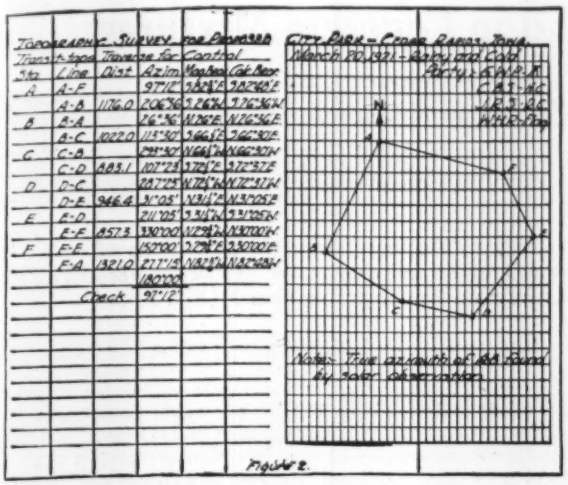


FIG. 2. HORIZONTAL CONTROL OF SURVEY

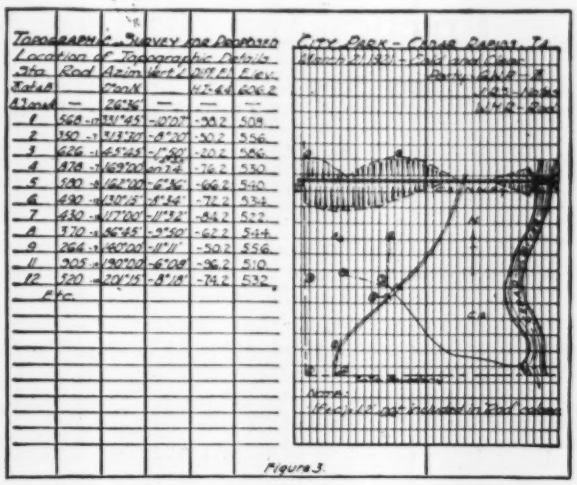


FIG. 3. SAMPLE PAGE OF STADIA NOTES

control. The traverse stations are selected according to good field practice and their locations are marked by small flags, consisting of bits of white cloth glued to toothpicks or matches. The side shots for the location of contour points and details are then selected and marked by small bits of paper on which are printed identification numbers and which are held in place by ordinary pins. Special care is taken to place these points so as to completely control the drainage net and principal ground forms with the fewest possible points.

These points are then located by co-ordinate measurements from the sides of the sand-box and are plotted on the instructor's map, on which the sand-box edges (co-ordinate axes) have previously been plotted to a reduced scale. The scales now in use are as follows: On the sand box the horizontal scale is 1:400, and the vertical scale is 1:200, on the map the scale is 1:2400 and the contour interval is 10 ft.

The elevation of the river bed on the bottom of the box is then assumed and the differences in elevation between it and all traverse and detail points are observed directly on the sand-box by means of an engineer's level and rod. These values are enlarged in the proper ratio and the relative elevations of the points are entered on the instructor's map.

Next the azimuths and lengths of the traverse courses are carefully measured on the instructor's map with a Colby protractor and scale, and the results recorded in good note-book form. These measurements should be made with great care for the accuracy of the students' maps, to be made later, will depend on these notes. The latitudes and departures of the traverse are computed and adjusted if necessary to give a degree of accuracy consistent with the purpose of the survey and scale of the resulting map. This completes the reduction of the horizontal control to notebook form. (Fig. 2.)

The vertical control may be given to the students in the form of a set of differential level notes or if desired the elevations of the traverse stations may be given to the students outright. The side shots for the location of contours, points and details are determined by azimuths and distances, scaled in a manner similar to that used in locating the traverse stations.

These measurements furnish the horizontal distances and differences in elevation of all the detail points and it remains to compute a vertical angle and a rod reading which, if taken in the field, will yield these distances when reduced. This is best done by means of a stadia slide rule. A sample page of stadia notes is shown in Fig. 3, the inclined figures being those which are to be read to the students. The instructor's map is now contoured, finished, traced and used by the instructor to check the students' plotting and sketching.

It is now possible to place before a class of students the project of making a complete topographic survey and map which very closely approximates actual field conditions. They are given only the purpose of the survey. In consultation with the instructor they decide on the scale of map, and contour interval. With these conditions established, they decide on the instruments, methods, checks, allowable errors, personnel and organization of the party for each part of the work. While looking at the landscape model, they imagine a transit set up in the field. The instructor gives the readings as they would be taken in actual work and the class records these notes in proper form. An excellent opportunity is given the instructor at this point to indicate the principles which govern the selection of detail points and to point out the best methods of procedure.

Each student now reduces his notes, plots the points and constructs a map in the usual manner, except that in sketching the contours he has an actual situation before him to interpret, both by means of his plotted points and by inspection of the real configurations of the landscape. Sometimes the students are asked to exchange note-books so that one man plots another man's notes and consequently gains a comprehension of the uselessness of vague notes. The map is inked in colors, using the usual symbols and a report is prepared which approximates the report of a similar survey in the field.

The use of this device is established and justified because it possesses these advantages: (1) The work is independent of field weather conditions; (2) it enables the student to see the relation of each step to the entire project; (3) it enables the student to see the significance of controlling points, and of ridge and valley lines; (4) it gives a clear and comprehensive conception of the factors which govern the choice of instruments, methods, and personnel; (5) it emphasizes the importance of good note-keeping and affords excellent practice in this regard; and (6) it enlists the student's interest quite as much as the out-of-door work.

Practical Use of Excess Sand in Concrete Mixtures

Tests Prove Pit-Run Gravel Suitable for Concrete Pavements—Iowa Practice in Proportioning Mixes of Varying Sand Content

By R. W. Crum
Engineer of Materials and Tests, Iowa Highway Commission, Ames, Iowa.

APPROXIMATELY 187 miles of single-course concrete pavement were constructed in Iowa in 1920 and 1921. In 122 miles of this pavement, unusual concrete mixtures were used; the aggregates contained from 50 to 80 per cent sand instead of the 33 to 40 per cent which is common. To keep the quality constant, additional cement was used in the mixtures rich in sand. Judging from tests made daily during construction, and from observation of pavement in service up to one year, the quality has been consistently maintained although the mixtures range from a 1:2:3½ by volume to 1:2½:1 by volume.

In 35.43 miles of road, unscreened pit-run gravel was the aggregate. *The tests show that this road is as good in every way as those in which screened aggregate was used.* If the constituent particles are good and the material is clean, we conclude that, when properly handled, pit-run gravel is suitable for use in paving.

The advantages in the use of pit-run gravels and of mixtures rich in sand have been: First, reduced cost, and, second, ability to carry on projects not otherwise possible. A conservative estimate of the saving in the cost of the two years' work, is $144,000. At least 35 miles of pavement were completed, which would not have been built under other circumstances.

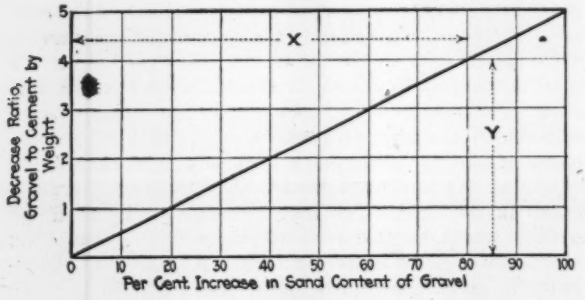


FIG. 1. DIAGRAM FOR PROPORTIONING CONCRETE MIXTURES OF VARYING SAND CONTENT

The method by which mixtures of varying sand content are proportioned, has been worked out by the Engineering Experiment Station of the Iowa State College from the results of some five years of experimental work. This method depends only upon the ratio of sand to total aggregate by weight. In the use of pit-run gravel, field control is very easily maintained since simple determinations of the percentage of sand in the gravel and the weight per cubic foot of the aggregate can be easily and often made.

Figure 1 is the basic diagram for proportioning mixes of varying sand content. To use this diagram the procedure is as follows. First assume a mixture known to be satisfactory, then: (1) Reduce the proportion of the standard mix to the basis of weight. (2) Determine from Fig. 1 the decrease in parts of aggregate corresponding to the increase in the percentage of sand in the aggregate and change the proportions accordingly. The formula for computing item 2 (Fig. 1) is:

$$\tan a = \frac{4.0}{80} = 0.05, \text{ and } y = x \tan a = 0.05\,x$$

Example: Assume that an aggregate containing 42 per cent sand, and weighing 112 lb. per cubic foot, makes a satisfactory concrete in the proportion of 1:4½ loose volume. What proportion should be used in a similar gravel containing 75 per cent of sand and weighing 107 lb. per cubic foot?

Assume that 94 lb. of cement equals 1 cu.ft. Then 1 cu.ft. of cement to 4.5 cu.ft. of aggregate equals 94 lb. cement to 4.5 x 112 lb. gravel, equals 1 lb. cement to $\frac{4.5 \times 112}{94}$. Therefore the proportion by weight is 1 to 5.36.

The increase in the percentage of sand is 33. From the diagram, the corresponding decrease in parts of aggregate is 1.6. Therefore, the proportion to use for the gravel containing 75 per cent of sand should be 1 to (5.36-1.6) or 1 to 3.76.

If it is desired to measure the materials by volume instead of by weight change the above weight relation to a loose volume proportion as follows:

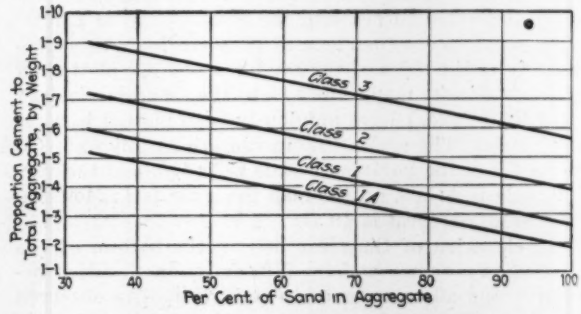


FIG. 2. MIXTURES OF VARYING SAND CONTENT FOR CLASSES OF CONCRETE IN COMMON USE

Weight per cubic foot of cement, 94 lb.; weight per cubic foot of gravel, 107.0 lb.; 1 lb. cement to 3.76 lb. gravel equals 94 lb. cement to 354 lb. gravel, equals $\frac{94}{94}$ cu.ft. cement to $\frac{354}{107}$ cu.ft. gravel, equals 1 to 3.30 by loose volume.

Fig. 2 is a working diagram for several classes of concrete in use by the Iowa Highway Commission. Class IA is the one in present use for single course concrete pavement.

Two 6 x 12-in. cylinders for crushing tests, and two 8 x 8 x 5-in. blocks for wear tests were made each day from concrete going into the roads. These specimens were cured and stored in a manner similar to the conditions of curing in the pavement. At the same time, the cement was removed by washing from a sample of concrete from the same batch, and a sieve analysis was run upon the aggregate. These data represent 46.17 miles of pavement built in 1920, and divided as follows:

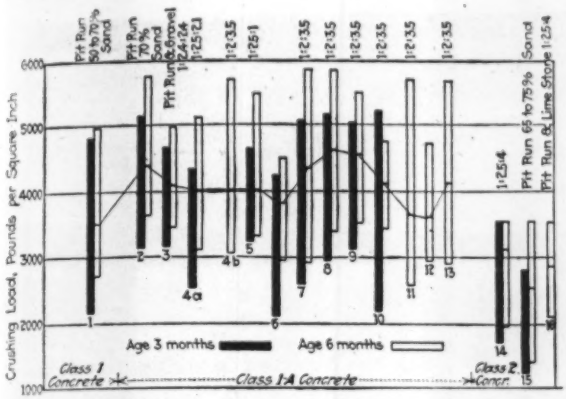


FIG. 3. STRENGTH TESTS OF FIELD SPECIMENS OF PAVEMENT CONCRETE

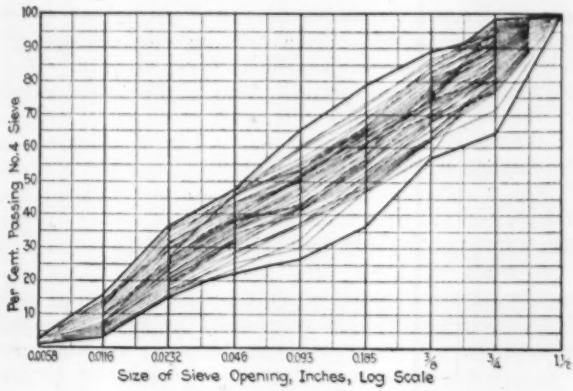


FIG. 4. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 1

Single course concrete, pit-run gravel	5.52 miles
Single course concrete, screened aggregate 50 to 80% sand	8.04 miles
Single course concrete, screened aggregate, 1:2:3.5 by volume	21.81 miles
Base course for brick, pit-run gravel	5.42 miles
Base course for brick, screened aggregate, 1:2:5.4	5.38 miles

It is to be expected of specimens made in this way, under field conditions, that there will be considerable variation in individual results. However, if a considerable number of specimens are used it is reasonable to expect that the average will be representative of the strength of the concrete, and that the variation in the individual results will give some measure of the comparative uniformity on different jobs. Of course many variables enter into the control of strength and uniformity. No attempt has been made to study the effect of the various conditions. We have drawn only one conclusion and we believe that to be substantiated.

We believe that it is entirely possible to design and construct pavements using pit-run gravel, or high ratios of sand to coarse aggregate, equivalent to pavement made from the common arbitrary mixtures such as 1:2:3.5, provided the same standards of supervision and inspection are maintained.

Crushing Tests.—Results of tests at the age of three and six months on concrete single-course pavement are shown by Fig. 3. The three months' specimens were made late in the fall and when studied with respect to weather conditions show a decided tendency toward decrease in strength as the days upon which they were made grew colder. Taking into account the varying conditions as to source of materials and methods of operation it would appear that there is no greater variation in strength between the high sand ratios and the 1:2:3.5 mixes or between screened and unscreened mixes, than there is between any two of the 1:2:3.5 mixes. Project 1 is class 1 concrete and 14, 15 and 16 are base concrete, while all of the others are class 1A concrete (Fig. 2). In view of this difference the average for No. 1 is not inconsistent.

Sieve Analysis.—Other qualities being equal, the principal objection to the use of pit-run gravel has been the fancied lack of uniformity in the resulting concrete. It is true that these experiments show that there is a great opportunity for improvement in the uniformity of concrete mixes, but, it is rather surprising to note that the mixtures of screened aggregates are no better in this respect than pit-run gravel mixtures, and often not so good when the pit-run gravel is handled in the most advantageous manner. Figs. 4, 5 and 6 show the sieve analyses (upon four typical projects) made daily upon samples of concrete from which the cement had been removed by washing. Fig. 4 refers to project No. 1 in Fig. 3 and is the worst example of variation in the pit-run gravel mixes. In this case the material was hauled direct from the pit to the road and strung along the subgrade. This method of handling pit-run gravel is the worst possible and should not be permitted. In order to compensate for the variation in sand content, three different mixes were used on this job.

Fig. 5 refers to project No. 2, a pit-run gravel job in which the material was properly handled. The gravel was piled by the excavating machinery in a large stock pile containing more than 1,000 cu.yd. of material. Gravel taken from this stock pile and measured in industrial railway batch-boxes showed such uniformity of

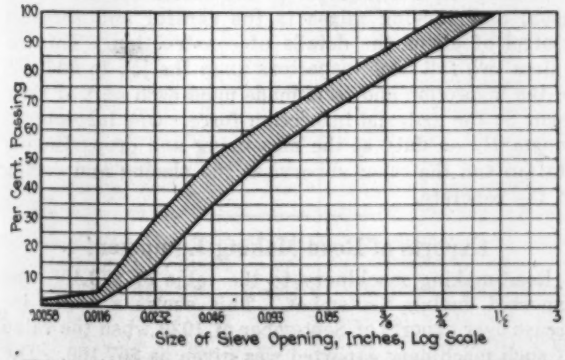


FIG. 5. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 2
Hatched portion is area in which sieve analysis curves fall

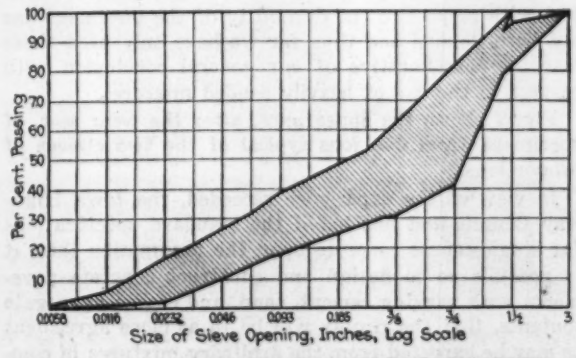


FIG. 6. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 8
Hatched portion is area in which sieve analysis curves fall

the sand content that for the entire project of eleven miles there was no occasion to change the proportions. The sieve analyses on the samples taken from the mixer corroborate this uniformity. This is the best example of the use of pit-run, but is much more nearly typical of the results being secured than is Fig. 4, which refers to obsolete methods of handling.

Fig. 6 refers to project No. 8 and is typical of the results secured with screened aggregates. It is neither the worst nor the best case noted in 1920.

A study of these data further substantiates our opinion that it is possible to make concrete with as uniform composition from unscreened as from screened aggregates. However, all gravel deposits are not suitable for use as unscreened gravel. In practice, before the use of pit-run gravel is authorized, the Highway Commission engineers assure themselves by thorough investigation that the deposit is capable of producing reasonably uniform and high quality material. These 1920 observations with respect to sieve analyses are also corroborated by similar data accumulated in 1921, in the construction of 140 miles of pavement.

TABLE I. WEAR TESTS OF CONCRETE TAKEN FROM PAVEMENT CONSTRUCTED IN 1920

(Age of Specimens about six months)

Project Number	No. Specimens Tested	Wear in Inches	Project Number	No. Specimens Tested	Wear in Inches
1	64	0.40	7	28	0.43
2	22	0.47	8	12	0.43
3	16	0.45	9	18	0.39
4a	26	0.37	10	33	0.42
4b	28	0.31	11	32	0.41
5	41	0.46	12	21	0.39
6	6	0.43			

Wear Tests.—The results of wear tests are given in Table I. The specimens were tested in a Talbot-Jones rattler, according to the method used by the Structural Materials Research Laboratory at Lewis Institute. The result of this test is reported in inches of wear, which is the average depth worn off of the specimen. Inspection of these data corroborates the general conclusion that there is a reasonable uniformity in results on the various jobs. Such a wide variation in conditions is represented that no refined comparisons can be made on the basis of the average depth of wear. Visual examination of the blocks is more illuminating. While the average depth of wear is very nearly the same for the different mixtures, it is seen that those concretes having a high ratio of sand to coarse aggregate, show a much more uniform wear than those concretes containing more coarse aggregate. The exact significance of this test with respect to the durability of the pavement has not been defined and thus far we have only used these tests as corroborative of our general conclusion with respect to the use of heavily sanded mixtures.

Fig. 7 shows the appearance, after the wear test, of specimens from five jobs typical of the two classes of proportions.

In view of the experience recorded, the Iowa Highway Commission has based the standard specifications for single-course concrete upon the assumption that, it is possible so to design and construct concrete pavements with varying cement, sand, and coarse aggregate contents, that the results will be in as close agreement as may be expected from the arbitrary mixtures in common use. Furthermore, the more heavily sanded mixtures have at least two quite important advantages:

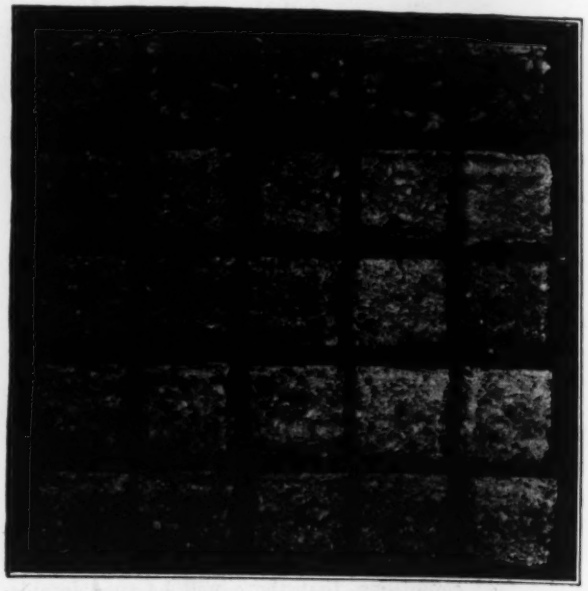


FIG. 7. TYPICAL APPEARANCE OF SPECIMENS SUBJECTED TO TALBOT-JONES WEAR TEST

1. It is quite generally accepted that if the voids in the coarse aggregate are more than filled by the cement and sand mortar, the internal grading of the coarse aggregate will have little effect upon the strength of the concrete. Such being the case with the mixtures under discussion makes it possible to use certain aggregates which might not be suitable for use in the more common mixes.

2. In proportioning mixes of high sand to coarse aggregate ratio, the amount of the cement should be based upon the maximum amount of sand to be expected, then, when the amount of sand at times becomes less, the high ratio of cement to sand will more than compensate for the variation. For instance if the proportion be based upon 70 per cent sand and the percentage of sand falls to 60, the mix would have more cement than the 60 per cent of sand requires, and the variation would not be at the expense of the strength of the concrete. As shown by the sieve analyses, considerable variation is to be expected. Mixes, such as the usual 1:2:4, which are intended just to fill the voids in the coarse aggregate do not provide any such factor of safety and most of the variation is, therefore, more serious.

A most important factor in the successful use of unusual and varying mixes is the careful and accurate control of all of the details of construction. This requires two full time inspectors upon the job in addition to the inspection and tests made upon each unit of shipment by the material inspection force. One inspector is constantly on duty at the measuring and proportioning station and the other supervises the placing and curing of the concrete.

Exports of Road-Making Equipment

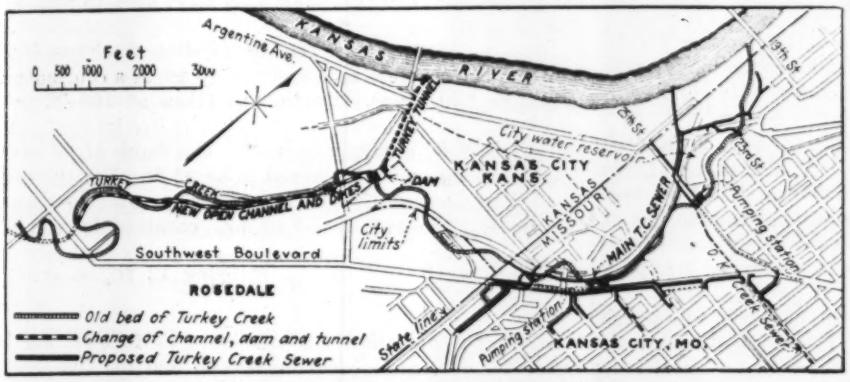
Road-making machinery to the value of $73,108 was exported during September. This shows a slight increase over exports of September of 1920 when the value of such machinery exported was given as $67,160. The figures are those compiled by the Department of Commerce.

Turkey Creek Sewer One of the Largest Yet Built

Relation of Sewer to Other Features, Contractual and Engineering, in Flood Control Problem of Kansas City—Design Data Given of 17 x 18-Ft. Double-Box Section Under Pressure

By Alfred D. Ludlow
Civil Engineer, Kansas City, Mo.

THE Turkey Creek sewer is the last step in a large flood protection scheme in Kansas City, Mo., which includes the Kaw River levees and the Turkey Creek tunnel. After many years of agitation the flood protection problem is well on the way toward solution. The engineering features consist mainly of diversion and sewer structures to carry off flood waters originating on the Turkey Creek drainage area, but not until these were constructed could the back water from the Kaw River be kept out of the lower parts of the city.



TURKEY CREEK SEWER DRAINAGE DISTRICT

The political boundary situation was involved almost inextricably because of the winding of the stream across state and municipal boundaries, to say nothing of the necessity of adjudicating and assessing benefits so that adequate funds could be raised. In this article the political boundary situation is outlined briefly, the engineering problem is stated and the design of the Turkey Creek sewer, which is one of the largest capacity structures of its kind yet built, is described.

In 1903 Kansas City was visited by a disastrous flood which inundated a large area on both sides of the state line and caused damage estimated as high as $22,000,000. The damage was caused mainly by the waters of the Kaw or Kansas River, which flows into the Missouri River at the intersection of the Missouri and Kansas state line with the latter stream. As a result of this flood, and another of much smaller magnitude in 1904, the Kaw Valley Drainage Board was created by the Kansas Legislature and a drainage district formed in Wyandotte County, Kan., to pay for widening, dredging and diking the river. This work has been practically completed and the lands which were flooded in 1903 are now believed to be safe from a flood of even greater magnitude, except at the mouth of Turkey Creek, across which the dike could not be constructed until the creek was diverted.

Turkey Creek, which heads in Johnson County, Kan., a few miles south and west of Kansas City, Mo., and drains an area of about 25 miles, enters Missouri near the intersection of 30th St. (produced) and the state line, flows in a northerly direction and crosses the line into Kansas again at a point just south of 19th St. in Kansas City, Mo., and about 100 ft. from the Kaw River, into which it empties. In ordinary times the flow in Turkey Creek is very small except for the sewage which it receives from Rosedale and Kansas City, Mo., for which it serves as an outlet for a number of sewers, the largest of which is the O.K. Creek sewer in Kansas City, Mo., which is a double-box reinforced-concrete sewer each side of which is 16 ft. in height by 15 ft. 8 in. in width at the outlet and which has a capacity of 7,436 cubic feet per second.

Due to encroachment on the channel of Turkey Creek by various property owners and railroads, and the construction of several pile piers in the stream, the channel has been so restricted that it cannot carry off the water in times of excessive rains. This has caused the flooding every few years of a considerable area of business and residence property along the Southwest Boulevard in Kansas City, Mo., near the state line. To relieve this condition a diversion tunnel has recently been completed under Greystone Heights in Kansas City, Kan., and the entire flow of the creek turned through the tunnel, leaving only the portion of the creek north of Mill St., in Rosedale, to be taken care of to make possible the construction of the dike across the mouth of the creek. Previous to June, 1916, at which time the writer was appointed engineer of sewers of Kansas City, Mo., contracts had been entered into with various railroad companies and the Kansas City Stock Yards Co., whereby these companies had contributed to the cost of construction of the Turkey Creek tunnel in proportion to the area of their lands that would be reclaimed by the construction of the Turkey Creek sewer, and Kansas City, Mo., had agreed to complete the construction of the sewer within two years after the completion of the tunnel.

Soon after taking charge of the department the writer began studying the Turkey Creek sewer problem. Considerable time had been devoted to this problem by other engineers and a contract had been entered into with the Kaw Valley Drainage Board providing for the construction of the sewer with an outlet into the Kaw River at the mouth of Turkey Creek. The route of the sewer, as shown on the plan attached to the contract with the Kaw Valley Drainage Board, followed very closely the route of Turkey Creek from 25th St. to the Kaw River and for a considerable portion of the distance between 23d St., and the Kaw River followed the route of the proposed 23d St. viaduct, now under construction. This route was several hundred feet longer than the route finally adopted and the difficulties of construction were much greater on account of the necessity of taking care of the flow of the creek which, north

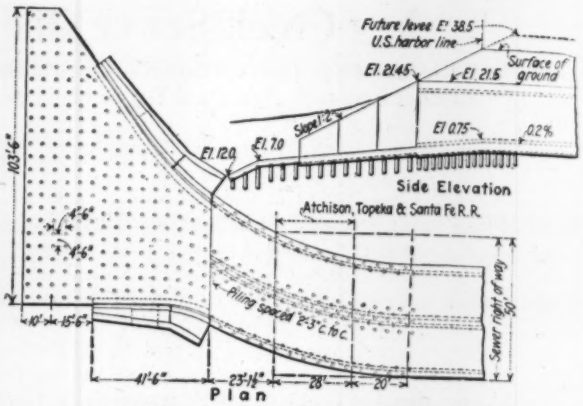
of 25th St., served as an outlet to the Kaw River for the O.K. Creek sewer previously mentioned, and also on account of the sewer being for several hundred feet under the 23d St. viaduct, which it was expected would be completed before the sewer was constructed. Finally, a more favorable contract with the Kaw Valley Drainage Board was obtained which permitted the construction of the sewer on the route shown on the accompanying general plan. A contract had also been entered into with Rosedale, Kan., whereby it had agreed to extend the construction of the proposed sewer west of the state line and remodel a portion of its sewer system to conform to the work to be done by Kansas City, Missouri.

Since the land along the route of the sewer and for a considerable distance on each side is below the elevation of extreme high water in the Kaw River it was necessary to design the main sewer as a pressure sewer and to construct, or reconstruct, the various laterals so that they would act as pressure sewers or go through a pumping station where in times of high water in the river the laterals could be shut off from the main sewer by means of sluice gates and the storm water and sanitary sewage be pumped into the main sewer.

The contract between Rosedale, Kan., and Kansas City, Mo., previously referred to, provided that all lands below El. 40, Kansas City, Mo., datum should be protected from overflow. This necessitated the closing of all openings into the lateral sewers below that elevation or diverting the sewers through several pumping stations.

The elevation of the levee at the mouth of the sewer at the present time is 32 but it is proposed to raise it to 38.5 as soon as the necessary funds are available.

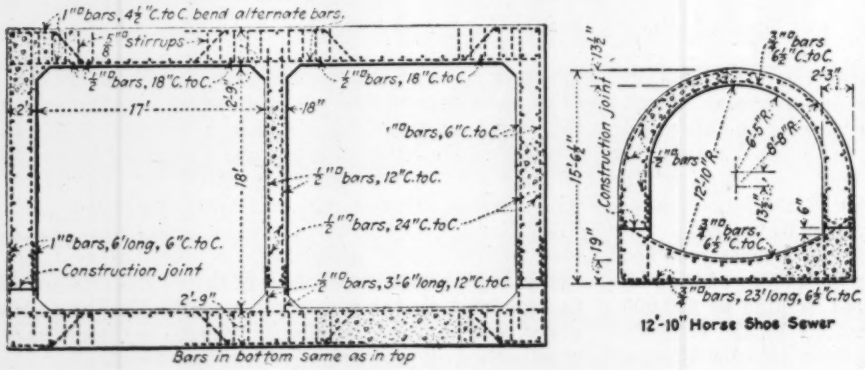
The main sewer, from its outlet to a point just south



OUTFALL STRUCTURE AT KANSAS RIVER

at all points. The following data were used in making the design:

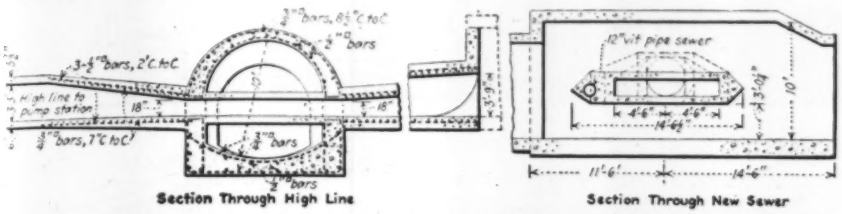
Design Assumptions for Double-Box Section.—The top and bottom were each assumed to act as a continuous beam of two spans. Earth was taken at 100 lb. per cubic foot and concrete at 150 lb. For live load a Cooper's class E-60 engine was used. The depth of fill over the top of sewer was assumed to be 12 ft. For the live load a transverse distribution at a slope of $\frac{1}{4}$ to 1 was assumed. The unit live load was obtained by use of the formula $W_L \quad \frac{12{,}000}{8 + \frac{H}{2}}$, H being 12 ft., as stated above. The final unit loadings were as follows: earth 1,200 lb. per square foot; concrete, 450 lb., live load, 860 lb.; total, 2,510 lb. The moment factor used was 1/10; unit fiber stresses, $f_c =$ 650 lb. and $f_s =$ 16,000 lb. Side walls were computed as a simple beam using the above loading and assuming the horizontal pressure to be one-third of the vertical. The moment factor used was $\frac{1}{8}$. The center wall was designed as a simple column. The effect of bursting pressure due to a head of water 15 ft. above the top of the sewer was considered for all parts of the structure and steel placed in the outer plane of the side walls to care for this internal pressure. Shear was duly considered and stirrups provided where needed. The box section of the main sewer will have a foundation of clean fine sand and it is believed no foundation piles will be needed except for the outfall structure. Preliminary excavations made to a depth considerably below the proposed bottom of the sewer and just inside of the levee showed that this sand carries no water whatever. Subsequent construction bore out this observation. The horseshoe-shaped section of the main sewer, being for nearly its entire length in the bed of Turkey Creek, and also the extreme east end of the O.K. Creek sewer extension, will require pile foundations.


1" ø bars, 4½" c. to c. bend alternate bars,
⅝" ø stirrups
½" ø bars, 18" c. to c.
½" ø bars, 18" c. to c.
17'
18"
1" ø bars, 6" c. to c.
½" ø bars, 12" c. to c.
½" ø bars, 24" c. to c.
1" ø bars, 6' long, 6" c. to c.
Construction joint
½" ø bars, 3'-6" long, 12" c. to c.
18'
2'-9"
Bars in bottom same as in top
17'X18' Double Box Sewer
3" ø bars, 6½" c. to c.
Construction joint
15'-6½"
19"
12'-10" R.
6'-5" R.
8'-8" R.
13½"
6"
¾" ø bars, 23' long, 6½" c. to c.
12'-10" Horse Shoe Sewer

SECTIONS OF DOUBLE BOX AND HORSE SHOE SEWERS

of 25th St., where the O.K. Creek extension comes in, a distance of 1,860 ft., will be a double reinforced-concrete box each unit of which will be 17 ft. wide and 18 ft. high. From this point south the main sewer will have a horseshoe section, there being 2,340 ft. of 12-ft. 10-in., 1,384 ft. of 11-ft. 4-in. and 1,017 ft. of 7-ft., or a total length of the main sewer of 6,600 ft. There will also be 28,000 ft. of laterals and connections ranging in size from an 8-in. vitrified pipe to a double 15-ft.-8-in. by 16-ft. reinforced-concrete box sewer.

The entire length of the main sewer and a considerable portion of the larger laterals will be under existing railroad tracks or so located that tracks may be constructed over them at any point. For this reason it was thought necessary to provide for a railroad loading



INTERNAL SEWER CROSSING AT ROANOKE ROAD AND SOUTHWEST BOULEVARD

openings are 5½ and 6 ft. above the flow line of the sewer no equalizing of the flow will take place until the sewer is running one-third full. Just below the junction of the 12-ft. horseshoe section with the double 17 x 18-ft. box section there are to be four 6 x 6-ft. openings through the middle wall, spaced 6 ft. apart. The openings at other points will be 5 x 6 ft., in groups of three. Openings 2 ft. wide by 6½ ft. high are also to be constructed in the middle wall opposite the pressure manholes so as to make it possible for anyone who is inspecting the sewer to pass from one chamber to the other.

At several points where lateral sewers cross Turkey Creek the barrel of the sewer will be reinforced to act as a beam and will be supported on concrete piers spaced from 14 to 16 ft. on centers.

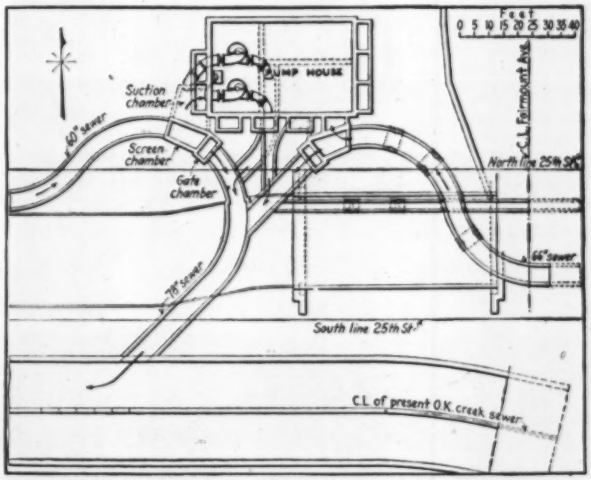
For the run-off factor the writer adopted the one deduced from his investigations in 1912 when designing the O.K. Creek sewer for the Kansas City Terminal Railway Co. (*Engineering Record*, Nov. 2, 1912, page 480.)

The main sewer, O.K. Creek sewer extension and Roanoke sewer were designed for a run-off of 1.5 in., with free discharge on actual grades. With the maximum flood in the river these sewers are good for a run-off of 1 in., using the hydraulic grades. Our investigations failed to reveal any time when the maximum rain has occurred at the time of extreme high water.

The stockyards sewer, which drains a very flat sandy area crossed by many railroad tracks ballasted with crushed rock and cinders, was designed for a run-off of 1 in. All small laterals were designed for a run-off of 2 in., which is the run-off used by Kansas City, Mo., for all short laterals. The total area tributary to the main sewer at the outfall is approximately 5,000 acres.

Pumping Stations.—Two pumping stations are to be installed to pump both sanitary sewage and storm water when the main sewer is under pressure or running so full as to cause backwater in the laterals and flood basements. One station will be located on the northwesterly side of the Southwest Boulevard near 28th St. The other station will be located on the north side of 25th St., immediately west of Turkey Creek. In the Southwest Boulevard station two 30-in. vertical, centrifugal pumps, having a capacity of 30,000 gal. per minute each against a maximum head of 30 ft., will handle storm water; one 10-in. centrifugal pump, having a capacity of 2,500 gal. per minute against a maximum head of 32 ft., will handle sanitary sewage. In the 25th St. station there will be two 30-in. vertical centrifugal pumps, having a capacity of 30,000 gal. per minute each against a head of 30 ft., and two 30-in. horizontal, centrifugal pumps having a capacity of 22,000 gal. per minute each against a head of 15 ft. All these pumps are of the volute, double-suction type, motor driven. Except the sump pumps and the sanitary pump in the Southwest Boulevard station, all units will be used only during times of high water in the Kaw River, into which the main sewer will discharge. This will be for only a short period of time each year and some years possibly not at all. The sanitary pump will be operated during times of high water and also during severe storms which will raise the elevation of the water in the main sewer to a point where it would back up in the sanitary sewers, although the water in the river might be below the pumping stage for the storm water pumps. This unit will be provided with an automatic float control and an electrically operated gong which will notify the watchman of the starting of the pump in order that he may close the gate valve on the sanitary sewer. The sluice gates, of which there will be two at the 25th St. station and one at the Southwest Boulevard station, will be operated through bevel gearing and shafting by 5-hp. motors.

A contract for the construction of the work was awarded in August, 1919, to Thomas Kelly & Sons, Inc.,



TWENTY-FIFTH STREET PUMPING STATION

of Winnipeg, Canada, for $2,453,750. As the work is to be paid for in special tax bills against all the taxable property in the drainage area, and there was some doubt as to the validity of the tax bills on account of a portion of the work being in Kansas, a friendly suit was brought to test the validity of the entire proceedings. A decision was rendered by the Supreme Court of Missouri upholding the validity of the proceedings in the summer of 1920 and construction work was started in October of that year.

Chicago City Drawbridges

Fifty movable highway bridges are maintained by the city of Chicago, the different types being as follows: 24 trunnion bascule bridges, 12 center bearing swing bridges, 12 rolling lift bascule bridges, one vertical lift bridge and one pontoon bridge. Of the trunnion bascule bridges, 22 are of the type developed by the city and the others are of the Strauss and Page & Schmable types. The pontoon bridge is across the Calumet River at Torrence Ave.

Concrete Grandstand Jacked Up to Allow Enlargement

Seating Deck Raised 12 Ft. and Capacity Enlarged—Steel Distorted by Fire Straightened or Replaced

By E. Robinson
Engineer, Terry & Tench Co., Inc., New York City

EARLY in the spring of 1917 there occurred a disastrous fire in the grandstand at the Belmont Park race track, Queens, Long Island, N. Y., which destroyed the entire roof and badly distorted the steel framing. The rear of the seating deck collapsed, together with portions of the mezzanine floor. Work on cleaning up the debris was started immediately after the fire, and a portion of the stand was arranged temporarily so that the spring meeting of 1917 opened according to schedule. Last fall it was decided to increase the seating capacity to 17,500, a feat accomplished in the following manner:

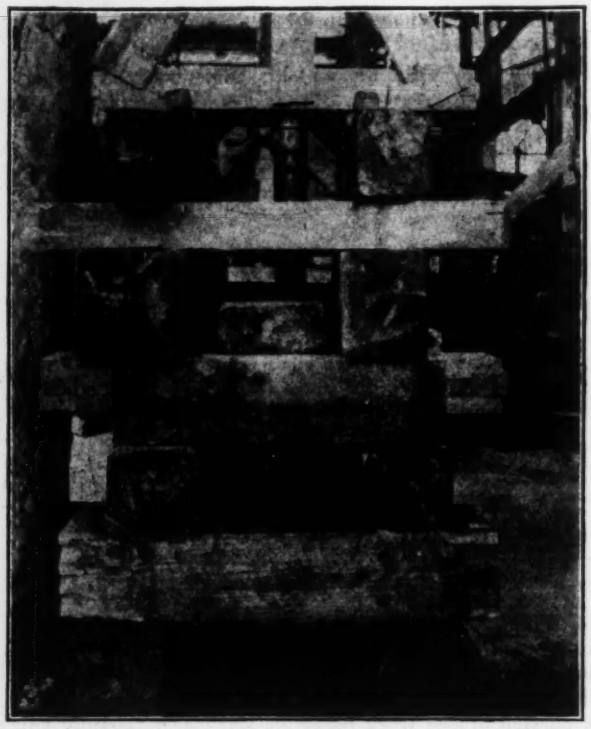


FIG. 1. METHOD OF JACKING AND CRIBBING SHOWING BOTTOM OF INVERTED T-SHORE

The old steel field stand, 125 ft. by 250 ft., which was situated about 250 ft. to the east of the grandstand, was taken down and joined onto the east end of the main grandstand at an angle of 10 deg., with a new connecting bay of 50 ft. inserted between the two stands. First about 25,000 sq.ft. of 3-in. concrete slab in the field stand was removed and all the steel framing marked with assembly marks upon the original erection plan. The original field rivets were burned and cut out and the steel taken down and thoroughly cleaned where rusted and given one good coat of red lead paint. Steel members which were found to be badly pitted were replaced with new material.

To line up the roof it was necessary to erect the old

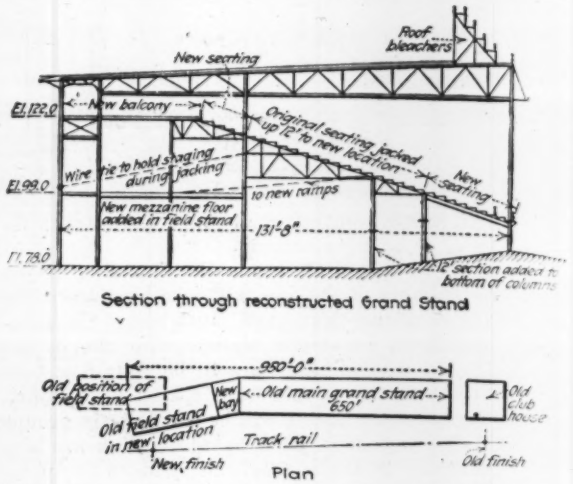


FIG. 2. PLAN AND ELEVATION OF RECONSTRUCTED GRANDSTAND

steel stand on concrete piers 6 ft. high and move up on the columns 6 ft. all the connections of the trusses carrying the seating deck. The roof of the old steel stand was carried out in front 21 ft. on a cantilever by adding new trusses and reinforcing others taking added stresses. It was found that the front columns were adequate to take the increased load, so replacement of those members was not necessary.

To add new seating in front of the existing seating area and to improve the line of vision in the combined stand it was found necessary to raise the existing seating area up a distance of 12 ft. above the original level. This was done by jacking and cribbing. The old grandstand was 650 ft. long and the seating area 52 ft. wide, being composed of steel trusses with a 3-in. concrete slab in steps of 1-ft. rise to 3-ft. tread, and weighing about 850 tons. This area was cut into three sections and jacked up to the new level by using fifty-seven ball-bearing screw jacks of a capacity of 15 tons each.

Jacking Operations.—The cribbing was built up around the jack with 10 x 10-in. timbers inverted to make a "T"-shore as shown in an accompanying photograph. The average distance jacked per day was about 12 in. When the staging had been raised a distance of 4 ft., a temporary shore was placed under the load and the cribbing was taken down. Then, after a 4-ft. piece had been spliced to the shore, the jacking operations were resumed until the next 4-ft. level was reached. Then again cribbing was taken down, the shore spliced, and the jack started from the base level. This method of changing shores was economical of cribbing and maintained the jack close to the ground. At each point where the shoring was spliced a longitudinal brace was placed consisting of two planks, each 2 x 10 in. in a "T" form and tied to the column with a sliding yoke brace. The columns were spaced 16 ft. 8 in. in a longitudinal direction.

Jacking of this large area of concrete surface 3 in. thick was accomplished without any damage to the concrete from cracking or from other causes, and progressed without any interruption or delay. Extreme care was taken that all parts jacked were kept in a level plane. Very little effort was necessary to operate the jacks.

When the jacking was first started the staging was

allowed to sag away from the columns about 1 in., being tied back securely to the rear of the stand with ½-in. wire cable and turnbuckles. This was done in order to clear the rivet heads of the columns, the cables being carefully watched and properly adjusted at all times. In addition to the back ties, the section being jacked was anchored at each end and crossbraced with ½-in. wire cable with turnbuckles. Each night before quitting time the load was released from all jacks by wooden wedges being driven hard up on top of the cribbing.

FIG. 3. ONE OF THE TWISTED STEEL COLUMNS WHICH WAS REPLACED

All through the stand were found steel members which were badly twisted and bent from the fire of 1917. All the old steelwork was carefully inspected. Top chords of trusses were buckled in places as much as 6 to 8 in. in sharp kinks, and columns which stood up and carried loads were found to have sharp buckles where the plates and angles bent together 5 in. out of line in a 2-ft. length of column. A large number of trusses were taken out and replaced, and where only top or bottom chords were damaged the load was taken off the truss and new material used. All punching was done on the job from plain material cut to fit. Columns which were badly kinked were cut out at the underside of the roof connection and just above the mezzanine floor, and new sections of a length of 20 ft. were spliced in.

In providing for the increased seating capacity ten new ramps were constructed. These ramps were 16 ft. wide and about 50 ft. long running from the center of the seating area to the rear. On the roof there was originally located a steel and concrete frame bleacher stand 600 ft. long. A length of this span 200 ft. long was cut off the west end, moved along the roof and joined onto the east end of the bleachers, this bringing it on top of the new bay and a portion of the reconstructed steel span. The moving of these bleachers and the arranging of the east end of the grandstand into boxes and inclosures for members of the club were required by the reversing of the direction of running the races, so that now the inside of the track is to the left of the horses.

The work was under the personal direction of Maj. August Belmont, president, and Joseph E. Widener, of the Westchester Racing Association, and Charles W. Leavitt, architect. The American Bridge Co. fabricated the steel. The general contractors on the work were the Terry & Tench Co., Inc.

FIG. 4. SEATING AREA JACKED AT FULL HEIGHT—PART OF STEEL FOR ADDITIONAL SEATING AREA IN PLACE

Pure Iron in Early American Bridge

BY D. M. STRICKLAND
Research Dept., American Rolling Mill Co., Middletown, Ohio

IN 1835 a wrought-iron arch bridge was erected between Brownsville and Bridgeport, Pa., near Pittsburgh, which has remained in service to the present day. It is in excellent condition from a corrosion-resistance standpoint. A local history published in 1903 by a Mr. Hart not only gives its date of construction as cited but also states that it is the first structural iron bridge built in America. The bridge is of special interest for this reason. The fact that the iron has withstood the corrosive elements for more than 85 years has attracted much attention and led to a chemical investigation of it.

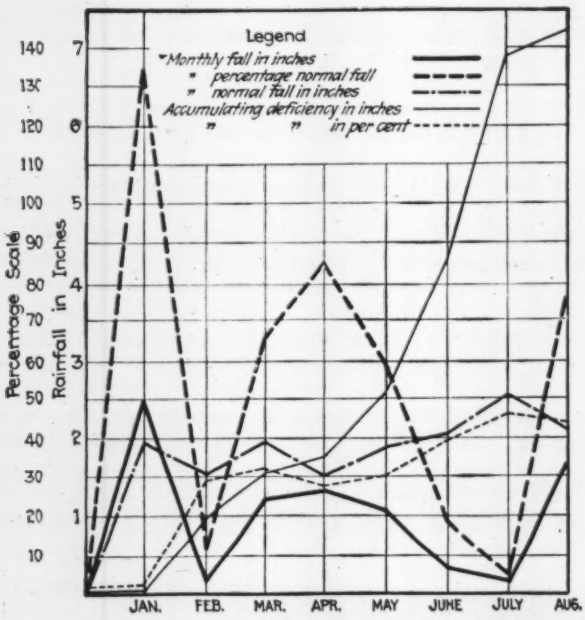
Recently the author had the opportunity to analyze a sample taken from this structure and found the old iron to be nearly as pure as the rust-resisting, commercially pure iron manufactured in openhearth furnaces at the present day. The analysis showed Si 0.05 per cent, S 0.025, P 0.200, C 0.037, Mn 0.003, Cu trace, N 0.006 per cent. This is a truly remarkable purity, considering the older inadequate manufacturing methods and lack of metallurgical and chemical control.

The iron of this historic bridge was manufactured in the town itself. It was made in the plant of John Snowden, an immigrant from England. His first forge and mill were built in 1824.

The Drought in the British Isles

(London Correspondence)

FROM the beginning of February to the end of September there were over 170 rainless days in England, and the country had received less than 60 per cent of its normal rainfall. In London only 8.32 in. of rain fell between Jan. 1 and Aug. 31, which is only 56 per cent of the average rainfall. The monthly falls in London, with their percentages of the normal, are shown by the chart. Indeed, so severe has been



RAINFALL AT LONDON, ENGLAND, IN 1921

the drought that England has this year bordered on the conditions found in semi-arid lands where the normal annual rainfall is between 10 and 20 in. These conditions have, however, not been uniform throughout the British Isles. In Scotland, the rainfall has kept around the normal, and, at the end of September, Scotland had an excess of 1.5 in. Ireland finished up in September 4.5 in. short, while England was nearly 9 in. below the normal fall.

Should England receive its normal fall during October, November and December, the economy measures put into operation in London and the other large cities will still be necessary.

In London, where the water supply is derived from the Thames, its tributary the Lea and a number of deep chalk wells, the Thames Conservancy and the Metropolitan Water Board have been hard put to it to ensure adequate supplies from the Thames and its reaches without involving any hazard to navigation. The Metropolitan Water Board has economized to the extent of 20 m. Imp. g.d., but appeals to the public are still being made and prosecutions and fines follow water waste, such as watering gardens or washing down automobiles with hose.

Construction has been begun on a new reservoir for London to hold 7,500,000,000 Imp. gal., but owing to the war and to government control this project had to be postponed. It was due for completion last year and will now be ready by 1923. London will be short of water until the Thames is replenished, since this river is its chief source of supply and long and heavy falls are necessary before the river returns to normal condition.

The other large cities have suffered to a greater or less extent. Those cities in northern England, such as Manchester and Newcastle, have been short but not to the same extent as the south of England where the drought has been most serious. Manchester, for instance, which has the reputation of being the wettest town in England, derives its supply from Thirlmere in the English Lake district. The dam here conserves 8,000,000,000 Imp. gal. of water for conveyance to Manchester about 90 miles away.

The Liverpool supply is obtained from Lake Uyrnwy in Wales, 68 miles away, and here the shortage has been badly felt, for Cardiff up to Aug. 31 had only 15.41 in. of rain, which is 57 per cent of the normal.

The Midlands are supplied from valleys in the Peak District of Derbyshire, except Birmingham, which obtains its water from the Elan valley in south Wales. Several cities have been very badly hit by the drought. In Bath, for instance, the springs are only giving 742 Imp. gal. a minute, against a normal of 1,300 gal. Here the water supply is cut off for 16 hours out of the 24 so as to conserve the springs as far as possible. The Revesby reservoir which supplies Boston is dry, and 22,000 Imp. gal. of drinking water are daily distributed in the streets at a cost of £200 per week. Many other cities, Brighton for instance, have their supplies cut off for 12 hours every day.

Survey of Underground Supplies

A geological survey has just been made of the underground water supplies of the counties of Buckinghamshire and Hertfordshire which afford much of the well water for London. In these counties the supplies derived from superficial gravels, and sandy beds of the lower tertiaries, are really insignificant, the main source being the chalk which has only one rival in Britain, that being the new red sandstone in the Midlands. The chalk formation here, while it may be regarded as homogeneous, from the point of view of water supply, possesses local differences which give rise to a certain amount of distinction between waters of the upper, middle and lower chalks. The results of this survey have shown that the water is derived from the joints and bedding planes rather than from the chalk mass, and that boring saturated chalk is of little use for pumping where there is an absence of fissures. A new survey is investigating this point and should be of great assistance to engineers in estimating the proportion of rainfall which can be expected to accumulate in any specific catchment area.

Such an unusual occurrence in Britain as a drought has prompted the Ministry of Health to collect particulars of the supplies of potable water in England and Wales, and to call attention to the advisability of taking advantage of the drought to ascertain the minimum available resources under exceptional weather conditions.

The drought has served to stimulate interest in water supply, in which branch development is badly behindhand. Had reliable data been available before the present drought it would have saved considerable sums of money which have been spent on elaborate supply schemes which have not been justified by results.

Combating Electrolysis in Water Pipe Systems

IN A paper entitled "Discussion of the Causes and Prevention of Electrolysis Troubles in Underground Pipe Structures" presented at the recent convention of the California Section, American Water Works Association, E. B. Stewart reviewed experiences of the East Bay Water Co., of Oakland, Cal., for which company he is electrical engineer. The paper touches upon three methods ordinarily used in combating electrolysis namely, surface insulation, drainage systems and insulation joints. The first of these was not considered important. Extracts from the paper dealing with the other two methods follow:

A drainage system for conducting electricity away from pipes by connecting them to rails or negative buses can be used to advantage under certain conditions as a secondary means of lessening electrolysis, but the installation of such a system as a principal means of electrolysis mitigation in a large city is unwise. In suburban areas where the pipe networks are small, a limited drainage system may offer the best means of dealing with the electrolysis problem, provided there is no appreciable leakage of current from the rails at points remote from the power station.

If the drainage system is used where the pipe network is steadily increasing the load continually increases, more and heavier bonds become necessary, and the current in the pipe finally becomes so great that any further extension of drainage would be a menace to the system. The placing of additional bonds between pipes transfers the trouble from where it has been most evident to a new location where it may require some time to manifest itself anew. Hence the intervening lull creates a favorable impression and has made the drainage system popular.

Danger of Bonding to Rails

Bonding to the rails at points remote from the power station should not be permitted. The disadvantage of such connections is illustrated by the following citation of experience in Oakland. At a point 2,900 ft. from the power house, indicating meter tests showed the pipe to be of positive potential to the rail and at the point where the pipe line crossed beneath the rails a connection was put in to lower this potential. In making the meter tests no account was taken of the potential of the rails with respect to the earth or to the likelihood of reversal of current flow from rails to the pipe during certain changes in the load distribution. The result was that while the bond between pipe and rail removed the discharge of current from the pipe to the rails, the pipe was still positive to the earth and a heavy discharge of current over the bond and into the earth took place, causing rapid deterioriation of the pipe near the point where the connection was made.

The safest and most economical plan for cases of this sort would be to enclose the pipe in a wooden conduit packed with insulating compound. This method is expensive, but serves the dual purpose of insulation at the point and reducing the amount of current that will accumulate on the pipe in outlying areas.

Pipes are often damaged on streets where there are no car tracks. In one case, where a number of services were found to be leaking, investigation showed that a cable conduit passed directly beneath them. The services were one-tenth of a volt positive to the cables. In this case the soil was wet clay and the nearness of the pipe to the conduit made up for the comparatively low potential. This illustrates the necessity for conducting tests between pipes and underground cable systems. In laying service pipes, cable conduits should be avoided even more than street car tracks. This is much more important in wet clay than in sandy soil.

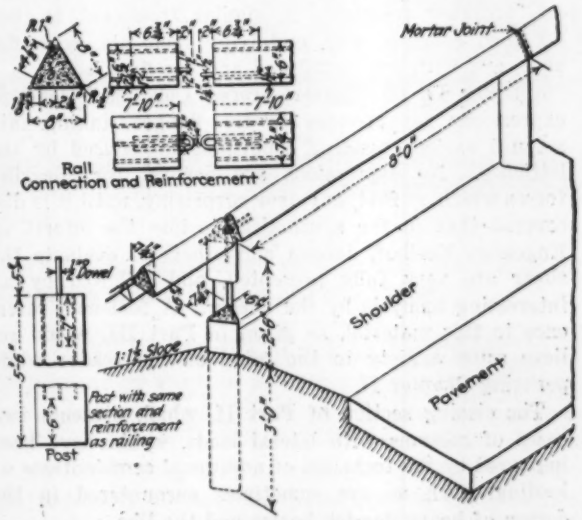
The most valuable means of mitigating electrolysis troubles lies in the proper use of insulating joints and the extensive use of such joints should be encouraged in new work and in making repairs. The objection to their use and the danger to be guarded against is a combination of conditions that will permit the current to shunt around the joint and cause destruction of the pipe on the positive side of the shunt. The kind of joints best suited to certain conditions, their spacing and complications arising from the nearness of other pipe systems not so insulated are all important factors that must be taken into consideration to secure adequate protection.

As a general rule, when a pipe line is laid with an insulating joint at every fourth or fifth length of pipe, the line has such a high electrical resistance that no measurable current will flow in it, even though considerable current is flowing parallel in the earth nearby. On wrought iron and steel pipes it has been found necessary to increase the efficiency of the joint by surrounding both joint and pipe with a wood box packed with insulating compound. The advisable length of such boxes will depend upon the resistance and amount of current in the earth. Although the box does not materially increase resistance, it gives a more even distribution of leakage current and is therefore a considerable advantage when the resistance of the surrounding soil is very low.

For the Oakland system the flanged type of insulating joints has been found the most desirable and economical for use on wrought iron and steel pipes. This joint is made up of a disc of red or gray fiber between the surfaces of the flanges, and washers of the same material under heads and nuts of the bolts. For pipe with bell-and-spigot joints a short wooden ring is used between the inside of the bell and the end of the spigot to prevent metallic contact and the joint is then calked with cement.

Inexpensive Concrete Guard Rail

A REINFORCED concrete guard rail, which simplifies the problem of precasting and is easy to erect, is being employed this season by L. D. Brownell, division engineer, where wood guard rail has to be replaced in the Fourth Division, New York States Highways. The post and rail are of the same section, as is indicated by the illustration, so that a single V-trough mold serves for both. In casting the rail, the stirrups, which hook over the dowel pin in the post, are given sufficient length to take up slight variations in spacing the posts. A mortar joint, carefully pointed, protects the metal parts of the connection and gives the rail a neat paneled appearance. As installed this year the railing has cost about a dollar a lineal foot.



REINFORCED-CONCRETE GUARD RAIL, N. Y. STATE HIGHWAYS

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Comprehensive Treatise on Columns

REVIEWED BY FRANCIS P. WHITMER
Consulting Engineer, New York City

COLUMNS: A Treatise on the Strength and Design of Compression Members—By E. H. Salmon, D. Sc. (Engineering) London, Assoc. M. Inst. C. E. From a Thesis Approved for the Degree of Doctor of Science (Engineering), in the University of London. London: Henry Frowde and Hodder & Stoughton. Cloth; 6 x 9 in.; pp. 279; illustrated. 31/6 net; postage 1s. extra.

This remarkably comprehensive treatise, comprehensive in the historical, theoretical and experimental aspects, is divided into three parts: a 16-page bibliography, and sections devoted to the "analytical" and "synthetical" aspects of the subject.

The bibliography covers nearly 400 references, arranged chronologically, to work of European and American investigators over a period from 1729 to 1920. It is so complete that the omission of Prof. S. W. Robinson's paper, "Strength of Wrought-Iron Bridge Members," (Van Nostrand Science Series, 1882) attracts notice. This valuable little work develops a general method for the solution of problems in combined bending and direct stress, solving a number of special cases, only two of which are presented by Dr. Salmon.

Chapter I of Part II, "Analytical," develops a series of general expressions for a flexed column, which are applied first to a round-ended "ideal column" and then in turn to round-ended columns with initial curvature, initial eccentricity and variable modulus of elasticity, finally combining all three conditions in what is termed an "ordinary column." A similar treatment is then accorded columns with end-fixing moments, with flat ends, and with one round end and one fixed end.

Chapter II, on "Lattice-Braced Columns," develops expressions for stresses in the flanges, taking into account various bending conditions introduced by the latticing. No expressions are derived for shearing forces which, at first, is rather surprising, until it is discovered that in the synthetical section the efforts of Engesser, Keelhof, Jansen and others to evaluate the shear are very fully presented, and followed by an interesting analysis by the author. A foot-note reference to this material, as given in Part III, would relieve some anxiety in the mind of the reader while perusing Chapter II.

The closing section of Part II, which presents two cases of columns with lateral loads, would have been improved by the inclusion of additional combinations of loading, such as are sometimes encountered in the design of heavy derrick booms and the like.

As a general comment, it may be said that the analytical work would have lost none of its practical value and its somewhat forbidding aspect would have been relieved if the analyses had generally terminated with the derivation of the maximum column deflection, instead of being developed into expressions for resultant fiber stress. Moreover, the practical value of many of the simplified expressions for fiber stress is lost by reason of the author's assumption of a minimum factor of safety of 4 as compared with the ultimate load given by Euler's formula. This factor is much higher than that corresponding to any of the formulas used in current American practice.

Part III, "Synthetical," comprises an exhaustive compilation of the theoretical and experimental work of the last two centuries, logically presented and ably discussed. Practically every known type of column formula and every reported column test receives attention. The many difficulties in the way of a practical formula with a purely theoretical basis are emphasized, and the conclusion is reached that some type of empiric formula in agreement with experiment is the best to adopt, preference being finally expressed for the Johnson parabola tangent to Euler's curve. Among matters demanding attention in future research is mentioned "the degree of imperfection common in practical direction-fixed ends," involving the problem of secondary stresses as affecting the deflection curve of columns in a framed structure, undoubtedly a vital obstacle to a satisfactory theoretical consideration of columns as encountered in practice.

The notation and the analytical methods employed in the book are very logical and clear. The typography and the figures are satisfying and quite free from important errors. On the whole, the book is perhaps the most complete work upon the subject of columns in all its aspects that has yet appeared, and seems to leave but little unsaid.

Light on the Problem of Social Justice

THE UNSOLVED RIDDLE OF SOCIAL JUSTICE—By Stephen Leacock, B. A., Ph. D., Litt. D., F.R.S.C., Professor of Political Economy at McGill University, Montreal. New York and London: John Lane Company, Toronto: S. B. Gundy. Cloth; 5 x 7 in.; pp. 152; $1.25.

Unsolved though Prof. Leacock leaves the riddle of social justice at the close of his brilliant analysis, he does not fail to throw much bright light on its complexities and on the involved reactions that follow from any and all attempts at a solution that have ever yet been tried. Better yet, he offers concrete suggestions of wide appeal.

Skillfully the author shows the fallacies of the *laissez faire* and associated doctrines on the one hand and of socialism on the other. Either way lies disaster. High praise is given to Bellamy's "Looking Backward" as one of the best conceptions of the ideal socialistic state but it, like all other Utopias, will not stand the human work-a-day test. Progress lies along the line of still further social control, with opportunity opened to every child, employment aids for adults, an extension of the minimum wage and of shorter hours movements, and wise control of land speculation and other sorts of profiteering. Just how these principles and practices are to be extended the author cannot reasonably be expected to say in so short an essay and in view of all the uncertainties. In the main, progress must come through experience.

Those who do not know of Prof. Leacock's grasp of political economy and his literary ability can learn much of both to their profit from an hour or two spent in reading this stimulating volume.

The F. A. E. Survey of Waste in Industry

WASTE IN INDUSTRY—By the Committee on Elimination of Waste In Industry of the Federated American Engineering Societies, Washington, D. C. New York: McGraw-Hill Book Co. Cloth; 6x 9 in.; pp. 409. $4.

To make in a short time a survey that might afford a stimulus to industrial and commercial leaders, labor organizations and government officials, to attack anew and vigorously the elimination of industrial wastes, was the first large proposal made to the American Engineering Council by Herbert Hoover when he become its chairman. The task was brought to a conclusion in five months, and the complete report appears under the title, "Waste in Industry."

In the original plan the survey of ten industries was contemplated. This number had to be reduced to six: Building construction, men's ready-made clothing, boot and shoe, printing, metal trades and textile. Studies in transportation and bituminous coal mining were made but were not completed in time to be included in the report; the same is true of a regional survey of the industries of the city of Worcester.

The material gathered is presented in three parts: (1) A summary of the detailed reports; (2) six chapters, each of which consists of the engineer's report on one industry; (3) seven chapters of general reports, dealing with unemployment, strikes and lockouts, legal machinery for adjusting disputes, industrial accidents, health of industrial workers, eye conservation, and purchasing and sales policies.

It was the expectation when the survey was undertaken that its results could be expressed in a relatively few figures which would indicate the magnitude of our industrial wastes, or at least those of the particular industries surveyed. In fact, the plan was based on the assumption that by taking representative plants the results could be multiplied by factors representing the proportion which the whole industry bore to the plants surveyed and totals thus arrived at with some show of justification. He who approaches the completed report in the expectation of finding these quantitative indexes will be disappointed. No such composite figures are presented.

This does not mean, however, that the report is without value. In fact, it has very decided value and should stimulate efforts in wide circles to reduce industrial waste. And this is true not only as applied to those engaged in the industries assayed but to all who have contact with industry of any kind.

The value lies in the presentation of a method of industrial assay that can be rather easily applied to any industry; in the qualitative conclusions, i.e., in the definite classification of wastes and indication of the corresponding methods of elimination; in the quantitative results in certain industries, which results in general terms are transferable to other industries; and finally, in the stimulating character of both the specific industry and the general reports.

The method of assay consisted in obtaining by personal investigation by competent specialists the answers to 260 leading questions, falling into 58 main topics, which in turn were classified under three main heads—wastes in organization, including the human factor; wastes through deficiencies in technical knowledge, which was taken to embrace the physical factors (plant, equipment, design, etc.); wastes in plant utilization, which was interpreted as covering operations. As to each question subject, also, it was determined what per cent of the waste was due to management, to labor and to outside contracts. Scales were set for the guidance of the inquirers, so that the procedure in all the studies was uniform. The method, while necessarily requiring knowledge and judgment in application, is relatively simple and would help any experienced executive to form a fairly reliable estimate of the extent of his wastes.

The character of the wastes disclosed are classified and discussed under four heads: (1) Low production caused by faulty management of materials, plant, equipment and men. (2) Interrupted production, caused by idle men, idle materials, idle plants and idle equipment. (3) Restricted production, intentionally caused by owners, management and labor. (4) Lost production caused by ill health, physical defects and industrial accidents. Under each of these heads there are quantitative citations of losses in given industries, the whole conveying a definite impression—even though composite loss figures are not arrived at—of very great waste in our industrial functioning. The industrial manager or worker must be hardened indeed who does not feel quickened by this picture of wastes and the consequent opportunity for savings to individuals and companies and to the whole community.

From the reports on specific industries the same sort of stimulus is derived. The major causes of wastes, are, in most of the reports, clearly disclosed and the corresponding remedies pointed out. Of particular interest to readers of *Engineering News-Record* will be Sanford E. Thompson's report on the building industry, a careful and illuminating inquiry into building wastes. (For abstract thereof see *Engineering News-Record*, July 28, 1921, p. 169.) Mr. Thompson also made the study of the shoe industry, which presents an equally interesting, but naturally materially different situation.

Of the general reports those on unemployment and on health of industrial workers make a strong appeal and will prove well worth the careful reading of those who are concerned with industrial functioning and desire to see its wastes cut down.

All in all, despite the failure to produce composite figures indicative of the magnitude of industrial wastes, either in industry as a whole or in particular branches, American Engineering Council has rendered through this study a valuable public service. The report holds much helpful information as to classes and causes of waste and method of study and elimination.

Public Health Work in England

THE STORY OF ENGLISH PUBLIC HEALTH—By Sir Malcolm Morris, K. C. V. O.; President of the Institute of Hygiene; Fellow of the Royal Sanitary Institute. (English Public Health Series). New York: Funk & Wagnalls Co. Cloth; 5 x 8 in. pp. 166. $1.50.

Although going back to examples of the "scientific instinct" and of the "new humanity" in much earlier years the author confines himself chiefly to events of the last seventy-five years in this readable and inspiring sketch of the public health movement in Great Britain. The first and short-lived board of health was created in 1848, as a result of somewhat earlier investigations made by Edwin Chadwick and others. The work of this board and its successors, including particularly the Local Government Board and, of very recent origin, the Ministry of Health, is outlined, as are the activities of a number of leaders in public health work. The activities of local health authorities are also sketched. Stress is put upon the part played by sanitarians.

The Thermal Properties of Concrete

STUDIES ON COOLING OF FRESH CONCRETE IN FREEZING WEATHER—By Tokujiro Yoshida. Urbana, Ill.: University of Illinois, Engineering Experiment Station. London: Chapman & Hall, Ltd. Paper; 6 x 9 in.; pp. 63; illustrated. 30c.

THE THERMAL CONDUCTIVITY AND DIFFUSIVITY OF CONCRETE—By A. P. Carman and R. A. Nelson. Urbana, Ill.: University of Illinois, Engineering Experiment Station. London: Chapman & Hall, Ltd. Paper; 6 x 9 in.; pp. 39; illustrated. 20c.

The two bulletins noted here are unrelated except that they represent somewhat allied experiments made in the same institution.

Prof. Yoshida's "Studies on Cooling of Fresh Concrete in Freezing Weather" is an elaborate investigation of the thermal properties of setting concrete, which includes the establishment of thermal constants, diffusivity, and the ratio of emissivity to the coefficient of thermal conductivity. These sound as though they required a highly scientific intelligence for their understanding. That is a fact. The bulletin is of much more value to the laboratory man and the physicist than it is to the expert concrete worker, although the latter is evidently in the mind of the author. What the author does is to establish the thermal constants of a setting concrete under varying conditions of deposition, mixture, protection, etc., and with them as a basis work out a number of curves by means of which, aided by some elaborate equations, one can ascertain the temperature of a concrete. Knowing the temperature which is required for removal of forms, that is, the strength which concrete will reach under certain temperatures, one can then proceed more inteiligently to the removal of forms. Unfortunately, the data are so elaborately stated that there is great doubt if they will ever be used, in their present form at least, by the actual concrete placer.

The Carman and Nelson investigation is frankly for the physicist, although the values which they determine are required in certain kinds of engineering studies. Their experiments establish certain values for thermal conductivity and thermal diffusivity, which constants have not hitherto been available.

Equipment for Handling Materials

MATERIAL HANDLING CYCLOPEDIA—A Reference Book Covering Definitions, Descriptions, Illustrations and Methods of Use of Material Handling Machines Employed in Industry—Compiled and Edited by Roy V. Wright, Editor-in-Chief, Managing Editor, Railway Age, and Editor of the Railway Mechanical Engineer, Car Builders' Dictionary and Cyclopedia, and Locomotive Dictionary and Cyclopedia; John G. Little, Managing Editor, Railway Age and Robert C. Augur, Associate Editor. New York: Simmons-Boardman Publishing Co. Cloth; 8 x 12 in.; pp. 846; illustrated. Cloth, $10; leather, $15.

This volume is a super-catalog of materials handling equipment, with an extended glossary or list of definitions. It serves its purpose excellently in text and illustration. There are few devices that are not described or illustrated, and, with the glossary for detail, the user of handling machinery can locate such information he is likely to want. There is no critical discussion.

Part I, of about 140 pp., is composed of definitions presented after the manner of the various "Dictionaries" familiar to engineers and to railway men in particular. Part II is the body of the book, some 540 pp., and describes and illustrates in order hoisting machinery, package-handling conveyors and elevators, loose materials, conveyors and elevators, conveying machinery details, elevators, trackless transportation, industrial rail transportation and handling systems. With a final selected catalog section of about 100 pp., the purpose of the book as a gazetteer of handling equipment is well carried out.

Concrete Ties

CONCRETE RAILWAY SLEEPERS: Notes compiled by the Technical Section, Indian Railway Board, with an Introductory Note by F. G. Royal-Dawson, M. Inst. C. E., late Chief Engineer with the Railway Board. Calcutta: Superintendent of Government Printing. Paper; 8 x 13 in.; pp. 88; folding plates and other illustrations. Rupees 3, annas 4.

Single-piece ties and ties composed of pairs of rectangular blocks and circular bowls are represented in this publication in a miscellaneous collection of designs tried in numerous countries. Most of the experiments noted have been on a small scale. Much of the information is old, and collected from other publications. Further, it deals more with description than with records of service. Nevertheless, the monograph is of value in bringing together a mass of information for reference and study. One of the interesting features relates to designs for Indian railways. Owing to the extensive use of pots and bowls of cast iron and steel for ties in India it is natural to find similar designs in concrete. Actual experience, however, has been limited. Large drawings are given of some of these designs. No summaries or conclusions are presented, but it is evident that a concrete tie satisfactory for main track service has yet to be developed.

More New England Rainfall Statistics

In the September Journal of the New England Water Works Association (Tremont Temple, Boston, Mass.; 75c.), X. H. Goodnough, chief engineer, Massachusetts Department of Health, presents New England rainfall statistics for the years 1913 to 1920, supplementary to those given in his paper in the Journal for September, 1915, which came down to the close of 1912. Many new stations have been added since 1912 and some overlooked long-time records have also been included. Data for adjacent parts of Canada and New York are given. Monthly and yearly totals are given by years and averages by months and by years. Elevations of stations are given.

A Pictorial Industrial Magazine

Industry Illustrated, an 11 x 14-in. monthly magazine, has been launched (10c. a number or $1 a year; Engineering Magazine Co., New York City). The editor is John H. Van Deventer, formerly of the *American Machinist*. The reading pages consist almost wholly of halftones, with some text in large type. Among the articles in the first issue are "Inventors Who Have Made It Pay" and "The Passing of the Roustabout; The Mechanics of Moving Materials."

Power Map of New York Available

The United States Geological Survey has issued a large-scale map of the State of New York showing upon it all of the hydro-electric and steam-electric power stations, and the main transmission lines in the state (Washington, D. C.; 50c.). It is a clear and explicit map, and should be useful to many.

Fire Protection in Electrical Stations

Thirty-five pages of the October Quarterly of the National Fire Protection Association (87 Milk St., Boston, Mass.) are devoted to an article on Fire Prevention in Electric Power Stations from the Operator's Point of View, by F. A. Allner, general superintendent, Pennsylvania Water & Power Co.

PUBLICATIONS RECEIVED

ACCIDENT BULLETIN NO. 78 AND 79: Collisions, Derailments, and Other Accidents Resulting in Injury to Persons, Equipment, or Roadbed, Arising from the Operation of Steam Roads Used in Interstate Commerce. (1) October-December, 1920, and Year 1920. (2) January-March, 1921. Bureau of Statistics, Washington, D. C. Paper; 9 x 11 in.; pp. 94 and 190. 5c. per copy or 15c. per year from Superintendent of Documents.

AMERICAN SOCIETY OF CIVIL ENGINEERS: Index to Transactions, Volumes I to LXXXIII (1867 to 1920). Prepared Under the Direction of the Committee on Publications by Elbert M. Chandler, Acting Secretary. New York: The Society. Paper; 6 x 9 in.; pp. 272.
Papers are entered under (1) topics and (2) authors, in each case alphabetically by titles. Well done and useful.

THE AUTOMOBILE INDUSTRY AND ITS FUTURE—By Leonard P. Ayres, Vice-President, the Cleveland Trust Company. Cleveland, Ohio: The Company. Paper; 6 x 9 in.; pp. 32.
An interesting, painstaking analytical study of wide appeal.

BUILDING OFFICIALS CONFERENCE: Proceedings of the Seventh Annual Meeting, April 27-30, 1921. Springfield, Mass.: Fred W. Loomis, Building Commissioner, Secretary. Paper 6 x 9 in.: pp. 75.

DANIEL H. BURNHAM, ARCHITECT, PLANNER OF CITIES—By Charles Moore. In two volumes. Boston and New York: Houghton Mifflin Company. Cloth; 8 x 11 in.; pp. Vol. 1, 260; Vol. 2, 238; Illustrated. $20.

CONTRIBUCION AL ESTUDIO DE LOS RECURSOS HIDRAULICOS PARA FUERZA MOTRIZ EN EL PERU—Por El Inginiero Juan N. Portocarrero C. Contribucion Presentada a la Seccion VI Del Congreso Nacional de la Industria Minera. Lima, Peru: Imp. Torres Aguirre. Paper; 7 x 9 in.; pp. 64.

THE EDUCATION OF HEALTH OFFICERS — By George C. Whipple, Professor of Sanitary Engineering, Harvard University, Cambridge, Mass. Reprinted from the International Journal of Public Health, Vol. II, Nos. 3 and 4, 1921. The Author. Paper; 7x10 in.; pp. 35.

ELEMENTARY CONCRETE CONSTRUCTION—By Leon H. Baxter, Supervisor of Manual Training, St. Johnsbury, Vt. Milwaukee, Wis.: The Bruce Publishing Company. Cloth; 6 x 9 in.; pp. 101; illustrated. $1.25.
A book of instruction for the manual training student; how to make concrete products and to place concrete, illustrated by photographs of school boys at work.

FOREST EXPERIMENT STATIONS—By Earle H. Clapp, Assistant Forester, Forest Service, Circular 183, Oct. 1921. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 34. 10c. from Superintendent of Documents.

INDUSTRIAL WASTES FROM THE STOCKYARDS AND PACKINGTOWN IN CHICAGO: Report to the Sanitary District of Chicago, January, 1921. Albert W. Dilling, Chief Engineer; Langdon Pearse, Sanitary Engineer. Chicago: The District. Cloth; 6x9 in.; pp. 261.
An abstract of this report on activated-sludge, Imhoff tank, sprinkling filter, screening, and grease recovery tests was printed in *Engineering News-Record*, May 12, 1921, p. 815. Altogether, the tests covered nine years. A preliminary report was published in 1914.

MACHINE DRAWING: A Text and Problem Book for Technical Students and Draftsmen—By Carl L. Svensen, M.E., Assistant Professor of Engineering Drawing in the Ohio State University, Member American Society of Mechanical Engineers, Society for the Promotion of Engineering Education, etc. New York: D. Van Nostrand Company. Cloth; 6 x 9 in.; pp. 214; illustrated. $2.25.

MODERN ROAD BUILDING: Address by R. E. Fishburn, Chairman Pima County, Arizona, Highway Commission, before American Association of Engineers, Tucson, Arizona. Paper; 6 x 8 in.

PRACTICAL BUSINESS METHODS FOR ENGINEERS AND CONTRACTORS AND ARCHITECTS—By Frank R. Walker, Assoc. Am. Soc. C. E. Chicago: 2209 Archer Ave., Frank R. Walker Co.; 8x11 in.; pp. 80.
Forms and methods of construction accounting for contractors, engineers and architects.

PRICE CHANGES AND BUSINESS PROSPECTS—By Leonard P. Ayres, Vice-President, Cleveland Trust Company, Cleveland, Ohio. Paper; 6 x 9 in.; pp. 27. Illustrated.
An unusually clear and readable study in brief compass. Gives (with 1914 as basis) changes in cost of living and also in wholesale and retail prices, 1915 to 1921, for the United States; wholesale prices for the same period in the United States, England, France and Italy; wholesale prices in the United States for 110 years and weekly wages for 100 years, for artisans and common labor; prices for 25 selected industrial stocks for 22 years; and a brief summary and forecast. One of the conclusions is that we are probably "entering upon an extended period of falling prices, broken by occasional shorter periods of rising prices." Urges accumulation of data that will show business cycles, and keen watchfulness to note our position in the cycle at every moment.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES: Year 1920, with Notes on Mine Accidents Due to Explosives. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 44.

QUEBEC STREAMS COMMISSION: Ninth Report, 1920. Quebec, Canada: Louis R. Proulx. Paper; 7 x 10 in.; pp. 139.

REPORT OF THE PUBLIC SERVICE COMMISSION OF THE STATE OF NEW YORK: Year ending Dec. 31, 1917. Vol. III. Statistics of Light, Heat and Power Companies. New York. Bureau of Statistics and Accounts. Cloth; 6 x 9 in.; pp. 605.
Another example of long delay in publishing governmental reports, but apparently not chargeable to the commission.

THE ROCKEFELLER FOUNDATION: A Review for 1920; The Program for 1921—By George E. Vincent, President. New York: The Foundation. Paper; 6 x 9 in.; pp. 47; illustrated.

SALIENT FEATURES OF ELECTRIC COOKING, ELECTRIC HOT WATER HEATING AND ELECTRIC HOUSE HEATING—By Samuel S. Wyer, Consulting Engineer. Columbus, Ohio: The Author. Paper; 6 x 9 in.; pp. 31.
Conclusions adverse; based largely on research and opinion published by Idaho Public Utilities Commission in 1918 and 1919.

SCIENCE AND COMMON SENSE IN WORKING WITH MEN—By Walter Dill Scott, President of Northwestern University; President of the Scott Company, Philadelphia; Formerly Director of the Committee on Classification of Personnel in the Army, and President of the American Psychological Association; Author of "Influencing Men in Business," etc. and M. H. S. Hayes, Member of the Scott Company, Philadelphia; Formerly Associate Psychologist, Laboratory of Social Hygiene; Joint author of "Delinquent Women in New York State." New York. The Ronald Press Co. Paper; 5 x 8 in.; pp. 154. $2.
Deals with means of judging the ability of men in different grades and in various branches of industry and business. Advocates and explains scientifically devised physical and mental tests, studies of character, history, and desires of individuals in relation to being hired for a new position or changed to one better suited to the man and woman. More of an argument for scientific tests tempered by common sense than an exposition of how the various tests should be made.

SEE UND SEEHAFENBAU — By H. Proetel, Regierungs und Baurat in Magdeburg. III. Teil. Wasserbau. 2 Band; Hand: bibliothek fur Bauingenieure, edited by Robert Otzen, Geh. Regierungsrat, Professor an der Technischen Hochschule zu Hanover. Mit 292 Textabbildungen. Berlin. Verlag von Julius Springer. Cloth; 7 x 10 in.; pp. 221. 40 marks.

THE SMITHSONIAN INSTITUTION: Annual Report, 1918-1919. Washington: The Institution. Cloth; 6 x 9 in.; pp. 557; illustrated.

SOPHOMORE ENGLISH FOR ENGINEERS—By D. B. Cofer, Associate Professor of Department of English, Agricultural and Mechanical College of Texas. College Station, Tex.: The Author. Paper; 6 x 9 in.; pp. 20.
Contains a short address by the author on "English for the Engineering Student," delivered in 1917; lists of (1) books and articles, (2) technical journals and (3) biographies for outside reading, oral reports, etc. The address is an able plea for the study of English literature and composition by prospective engineers for cultural and utilitarian purposes, with a few notes on current instruction in English composition at the Agricultural and Mechanical College.

STANDARDIZATION OF MEASURES OF LENGTH AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—Ottawa, Ont., Topographical Surveys Branch, Department of the Interior. Paper; 6x9 in.; pp. 33; illustrated.

TECHNICAL EDUCATION IN RELATION TO RAILWAYS IN AMERICA—By H. L. Cole, O.B.E., M. I. Mech. E.; Locomotive Department, Indian State Railways, and Secretary, Railway Board. Technical Paper No. 219, Railway Board, Simla, India. Paper; 8x13 in.; pp. 46; illustrated. 14 Annas.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS: No. 197, Cementing Qualities of the Calcium Aluminates—By P. H. Bates, Chemist, Bureau of Standards. Paper; 7 x 10 in.; pp. 27; illustrated. Washington, D. C. 10c. from Superintendent of Documents. Limited number free on application.

TRAINING FOR THE PUBLIC PROFESSION OF THE LAW: Historical Development and Principal Contemporary Problems of Legal Education in the United States, with Some Account of Conditions in England and Canada—By Alfred Zantainger Reed. New York: Carnegie Foundation for the Advancement of Teaching. Paper; 6x9 in.; pp. 498.

UNION SCALE OF WAGES AND HOURS OF LABOR, May 15, 1920—[Wages and Hours of Labor Series] Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 280.
Ninth annual bulletin on this subject. Gives union wages and hours of labor of 1,054,204 persons in 12 groups of trades in 66 cities; also gives for each trade the per cent increase of wage rates in 1920 over each of the 13 previous years for the cities collectively.

THE VENTURI FLUME—By Ralph L. Parshall, Senior Irrigation Engineer, Carl Rowher, Irrigation Engineer; Irrigation Division, Bureau of Public Roads, U. S. Department of Agriculture. Based on Experiments Conducted in the Hydraulic Laboratory at Fort Collins, Col., at Cornell University, and at the field laboratory at Bellevue, Col., under co-operative agreement between the Irrigation Division of the Bureau of Public Roads, U. S. Department of Agriculture, and the Colorado Agricultural Experiment Station. Bulletin 265 (February, 1921), The Agricultural Experiment Station of the Colorado Agricultural College, Fort Collins, Col. Paper; 6x9 in.; pp. 23; illustrated.
An article on the early history of this device appeared in *Engineering News*, Aug. 10, 1916, p. 271. In *Engineering News-Record*, Sept. 2, 1920, p. 452, P. S. Wilson and C. A. Wright dealt with the experimental work at the Cornell Hydraulic Laboratory. The general subject was further discussed by Julian Hinds, *Engineering News-Record*, Dec. 23, 1920, p. 1223.

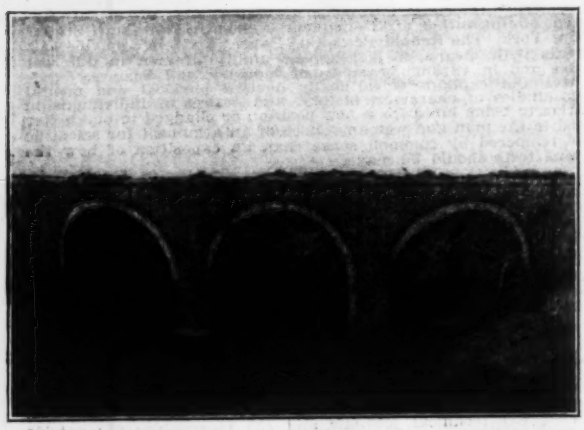
WATER RESOURCES OF KERN RIVER AND ADJACENT STREAMS AND THEIR UTILIZATION—Bulletin 9, California Department of Engineering, Based on Investigations in cooperation with Kern County, the Kern County Land Co., and the Tejon Ranch Co. Sacramento, Cal.: As above. Paper; 6 x 9 in.; pp. 209; eight separate maps and profiles.
The full utilization of Kern River is considered, including both power and irrigation uses, the development of storage and the utilization of ground water supplies.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Two Old Eccentric Arches

Sir—The illustration of an eccentric elliptical arch that appeared in a recent issue of *Engineering News-Record* prompts me in sending you a photograph of an old (perhaps ancient) aqueduct near the city of Chihuahua, Mexico, taken in 1899, in the belief that it may be of interest.



Taft, Cal. W. E. CONDON,
Civil Engineer.

Some Engineers Good Managers

Sir—"The Engineer a Failure as a Manager" offers another topic for extended and perhaps useful discussion.

Engineering News pointed out some thirty years ago that about 50 per cent of engineers with experience graduate from strictly engineering lines into executive positions. In view of old statistics and confirming data of a more recent date it does not sound reasonable to say that the engineer is a failure as a manager. Not all engineers are managers and not all managers are engineers, but executive positions have a persistent way of offering themselves to a goodly proportion of engineers.

No doubt the typical engineer as trained by experience or by our technical schools and experience is of a scientific and studious type, disciplined and conscientious; for him to be otherwise would be to deny his birthright. On the other hand imagination, vision and idealism are not the result of training but rather of inheritance and association. No good reason can be given why the engineer as a type should not have as large a degree of foresight as any other class. His collegiate training does not minimize idealism; why should his experience suppress this quality any more than the early novitiate which the lawyer and doctor serve? Was not James B. Eads inventive, imaginative and also a great manager? Ericsson had visions and realized on them in a most spectacular battle which revolutionized the navies of the world. George S. Morison was a great engineer and by no means a failure as a manager. Frank Thomson rose from surveyor to president of the Pennsylvania Railroad. He is generally considered to have been something of an engineer and one of the greatest railroad organizers of this or any other country. The history of the railway age will list a number of engineers who were managers with vision but not visionary.

The fact remains that our technical institutions have not helped seriously in training engineers to be managers, until very recently. We have courses in Business Administration, Engineering Administration, Industrial Engineering and no doubt they aid in developing engineers so that after due experience they may fill positions of an executive character better than without this training. The qualifications of a good manager are somewhat illusive and they develop with experience and usually with maturity. Whatever the difficulties may be they constitute no reason why the technical school should not consider the possibility of a training adapted more to the needs of a manager group where there is evidence of ability in that direction. It boots nothing to attempt to train all engineers as managers but it is important that the education of all engineers should be broad enough so that it does not hinder and does help them on their way to executive positions. Then some might well be given special training of a post graduate character and designed for the managerial type. R. L. SACKETT,

State College, Pa. Dean, School of Engineering,
Nov. 4. Pennsylvania State College.

Dirt Is Not Earth

Sir—A correspondent of *Engineering News-Record*, Sept. 29, says in substance: "Few if any of our engineering institutions lay sufficient stress on the importance of an engineer's ability to speak or write the English language correctly."

We must agree with this statement when we read in college textbooks of the construction of "dirt" roads when earth roads are meant. Specifications from a State Highway Department contain the statement, "cover the shoulder drains with dirt." Good scholarship is offended by the use of the term, dirt, except in ordering its removal from materials.

The professional engineers are now engaged in making a drive to secure license laws in many of the States. Doctors and lawyers are not licensed, but admitted to the bar on a diploma or examination. We license peddlers, auctioneers and formerly saloon keepers. In Michigan engineers are not licensed, but are registered after an examination or producing proof of qualification for the work of engineer or architect. There are a few engineering magazines that use the so-called simplified spelling. In the opinion of your correspondent, not many really able engineers would care to have their manuscript mutilated in that way. It would seem that in the many years since the founding of this nation the steady influx of foreigners, representing every known tongue, would have corrupted the English language. Such might have been the result had not Noah Webster stood like a rock, defending and protecting our language as Washington defended and protected our liberties. WINFIELD S. MERRILL,

Kalkaska, Mich., Oct. 14. Registered Civil Engineer.

Early Overloading of Concrete Floors

Sir—The writer is moved by certain articles which have appeared in your issues during the current year upon reinforced-concrete failures to express some conclusions which experience and observation have caused him to draw regarding reinforced-concrete design.

Probably no engineer will dispute the fact that it is not wise to permit green concrete in a building or other structure to be overstressed during construction. Collapse or failure may not occur, but the concrete is likely to be so damaged that it will give trouble later on by working and getting out of shape, although it may carry the load for which it is designed.

The loads which come upon the floors of such light buildings as office, hotel, apartment and school buildings, during the construction period are frequently much greater than any loads to which these same floors will be subjected after completion. When such floors are designed for a live working load of 40 lb. plus super-imposed dead-load of 20 lb., for example, they are almost certain to be overstressed by the construction loads. The contractor may be careful and conservative in handling his work, and the superintendent may be on the job and watchful, but brick, stone, sand or some other material will be piled on the floors and the damage done without the knowledge of those in charge of the work. There is a feeling prevalent among workmen

that reinforced-concrete floors will carry anything. Even though subcentering is placed throughout the building and kept in place as long as possible there comes a time when it must be removed so that work can proceed.

The writer believes that the floor slabs of buildings including joists and secondary beams should not be designed for less than 80 lb. per square foot live-load; and main girders for not less than 60 lb. per square foot as a minimum for any type of construction; for some types of construction these figures should be increased as much as 25 per cent. The columns of a building are not affected in the same way that the floors are by construction loads, and it is not necessary to be as conservative in designing the columns and column footings.

In determining the design live-load for floor slabs and beams there are several important points which should be carefully considered. A solid concrete slab which weighs say 80 lb. per square foot, and designed to carry a live working load of 80 lb. plus 20 lb. per square foot, may be loaded to 150 lb. per square foot and the material will be overstressed about 28 per cent. A light joist construction weighing 40 lb. per square foot and designed for the same working load, when loaded to 150 lb. per square foot will be overstressed about 36 per cent. If the live-load for which the two types are designed is 40 lb. instead of 80 lb. and each should be loaded to 120 lb. per square foot, the solid concrete slab construction will be overstressed about 43 per cent and the lighter construction about 60 per cent. This fact must be borne in mind by the designer and a larger live-load used in designing the lighter weight construction to provide against possible overloading of the floors during construction or after completion of the building.

The advantages of two-way and multiple-way reinforced-concrete slabs in carrying concentrated loads when compared with one-way reinforced slabs and beams, and to a still greater degree one-way joist and girder floor construction, are well known and appreciated by the engineering profession. This advantage must also be kept in mind by the designers of reinforced-concrete floors to provide for construction loads and also for possible concentrated loads after the building is completed. Girderless floors which carry the slab loads directly to the column need to provide for only the same loads that the main girders of a beam construction building would be designed. This follows as a matter of course.

The points herein brought forward should receive the consideration of those who are responsible for drafting building codes, and engineers who are responsible for the design of either reinforced concrete or steel buildings. It is not sufficient to establish minimum design loads without regard to the type of design that will be used.

It is entirely possible that if these matters are given their proper consideration there will be fewer failures of reinforced-concrete buildings. WALTER H. WHEELER,

Minneapolis, Minn., Oct. 22 Consulting Engineer.

Two Concrete Piers; A Lesson in Competitive Practice

Sir—There are in Manila Bay two reinforced-concrete piers which constitute a most striking and forceful illustration of the advisability of following correct construction principles.

Piers "A" and "B" (a designation used for the purpose of this article), are both flat-slab and girder decks founded on precast concrete piles. They were built simultaneously in 1914, under almost identical conditions. They are located about two thousand feet apart and subject to the same sea action. Excellent trap rock and screenings from the same quarry and sharp clean sand, dredged from the Pasig River were supplied for each. The same brand of cement taken from the same shipments and warehouse, and fresh clean water from the same pipe were used throughout. Pier "A" is subjected to vastly greater traffic than is Pier "B."

Pier "A," after seven years' hard service, is in splendid condition. A careful survey reveals no sign of serious concrete deterioration, nor rupture due to oxidized reinforcement. There are a few rust stains.

Pier "B," after the same length of service, is in an advanced state of disintegration. At least seventy-five per cent of the deck beams are cracked and spalled, many so seriously as to expose the entire side and bottom of the reinforcing. The bottom of the floor slabs and the pile haunches have spalled, exposing the steel in many places. Many other places, particularly on the bottoms and sides of the main floor beams, are cracked and bulged. A chisel inserted in a crack will bring off great flakes of concrete exposing steel which in every case is heavily corroded. The concrete appears to be of excellent quality. The floor slabs, beams and haunches are strained with rust. The concrete piles which were precast in special forms are in excellent condition.

Here we have two piers built under identical circumstances, one in perfect condition the other failing rapidly.

RUSTED STEEL CAUSES CONCRETE BEAM FAILURE

The answer? It is simple, simply this. The superintendent who built pier "A" used common sense. The builder of "B" violated two of the most fundamental principles of reinforced-concrete construction, particularly vital where the work is exposed to sea water.

When the steel was delivered to both piers, it was found to be incorrectly bent. The beam stirrups were too large and the longitudinal beam rods were bent too high. The superintendent on pier "A" stopped his job, and re-bent his steel. The superintendent on pier "B" was too busy to do likewise, so put the steel in as it came.

The serious damage to pier "B" is unquestionably due to heavy corrosion of the reinforcing steel because it was placed too closely to the surface of the concrete. Measurements taken at many places show that it was embedded but from ¾ in. to 1¼ in., which is entirely insufficient cover. This is an excellent illustration of the vital importance of deeply embedding the steel in rich impervious concrete, on all work which will be exposed to the action of sea water or salt air.

Another contributing cause of this failure was undoubtedly the practice in vogue on pier "B" of pushing the portable mixer, with piles of cement and aggregate out onto the new floor slabs within a day or two after they were poured. The vibration of the running mixer on this setting concrete was sure to open hair cracks, and weaken the bond between the concrete and steel. It is a practice to be condemned utterly on this class of work.

The writer has just finished two concrete piers in the same neighborhood. Portable mixing plants were used on each, which were not allowed to move out on a new piece of deck until it had been poured two weeks. As the piers were built out from the shore end this involved considerable wheeling of concrete.

Extreme care was exercised to the end that no portion of the reinforcing steel should approach nearer than 1¼ in.

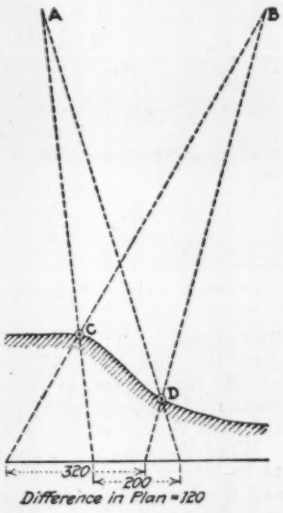
to the surface of the concrete. It is believed that this is insufficient for safety and permanence under conditions which obtain in tropical waters, particularly if the concrete will be exposed to any abrasion. The minimum depth of rich impervious concrete, measured to the nearest surface of the steel should be not less than 2 in.

Manila, P. I., Aug. 6 H. H. BRAUN,
Engineer-Contractor.

Some Weaknesses of Aerial Photo Maps

Sir—The article published in *Engineering News-Record* of Oct. 13, p. 596, on aerial photographic mapping is interesting so far as it refers to reconnaissance surveys, but when the writer attempts to show that photography may be substituted for ground methods of accurate surveying he is exceeding the limit of his subject. The principles of astronomy, trigonometry, geometry, geodesy and perspective cannot be consigned to oblivion as superfluous by simply pressing a button. It is not so easy as that. The use of aerial photographs for surveying has been investigated in Europe before and during the war—and the results achieved only served to demonstrate what was already well known to many surveyors, that for all practical engineering purposes the making of maps from photographs is impossible.

There are many things in the article referred to which would not stand the test of practical demonstration, but a reference to one or two may be sufficient to show the general debility. "Negatives, . . . by enlargement or reduction, can be brought to a uniform scale even though the airplane from which they are taken does not fly at a constant altitude." The perspective, or photographic distance between two points, may differ considerably from the horizontal, or plan, distance according to the shape of the ground and this cannot be adjusted by merely reducing or enlarging the picture. Nor will the correct altitude of the airplane with reference to one or two points be sufficient; the elevation of all points to be plotted must be ascertained with relation to a known datum, and if this cannot be done the picture will merely be a sketch map without a scale. In rolling or hilly country this is more noticeable. The altitude of the airplane is not the governing factor as may be seen from the diagram. The first position of the airplane at *A* overlooks two points, *C* and *D*, which are projected on the photograph, or picture plane, 200 ft. apart; the second position of the airplane, *B*, at the same altitude, projects the same two points, *C* and *D*, on the picture plane 320 ft. apart. This is only one of many discrepancies not referred to by aerial survey enthusiasts and it would be interesting to learn how such remarkable closures as "an error of less than one-half of 1 per cent" are arrived at. The city of Rochester may be on very level ground, but other results cannot be so easily explained.



The excerpts taken from the report of an "engineer" commencing—"An aerial map of the city would show more detail than we could ever hope to put on any plan prepared from surveys," etc.—become mere nonsense when compared with the photographic reproductions.

The last paragraph is very disheartening, when we consider its application to any of the photographs shown, and they must have been picked ones. "By placing tracing paper over the complete mosaic, all information desired may be traced off, thereby giving a line map without the photograph showing." Imagine the feeling of a draughtsman who was asked to make a ground line plan on tracing of the photograph on p. 597! He might get a little work done in the center of the picture, but outside of that it would be a hopeless task. Look at the E-shaped building, for instance, at the crossing of Park Ave. and 34th St.; judging by the roof there would appear to be 12 corners, but only one is visible on the ground line. The outer part of the picture is not in plan at all and would have to be treated as "oblique"—if, indeed, it was worth it.

The use of aerial photographs for making accurate plans is a very difficult proposition, but if we require relief, or contour, maps they cannot be considered in any shape or form.

The day of the airplane as a surveying instrument has not yet arrived, and the "old field tools" referred to in your editorial will have to be used for many a long day before a substitute is found for reliable mapping.

Winnipeg, Oct. 24. P. J. BARRY,
Dominion Water Power Branch, Department of the Interior, Canada.

Problems in the Chlorination of Water

SIR—The answers to Q. 9 in "Problems in the Chlorination of Water," *Engineering News-Record*, Sept. 15, p. 444, show a wide difference of opinion among plant operators. I believe this subject should be discussed further. The question was stated as follows: "Does the bacterial reduction effected by an excessive use of chlorine warrant letting down on the possible efficiency of filter plants? In other words, should filter efficiency be allowed to drop with the idea that the bacterial efficiency may be raised by a liberal use of chlorine?"

I believe that the question could have been better stated. The implication of inefficient plant operation is one that few operators would admit and justly so, if due to an intentional low percentage of bacterial removal by their filters. Also the wording "excessive use of chlorine" is ill advised. The question is better stated in the editor's note preceding the first article, p. 392, Sept. 8 issue, "Should plant operators strive less to produce a low bacterial count by filtration, relying on chlorine for that, and try to get 100 per cent clarification as economically as possible?"

In many cases the answer to this question should be "yes." Mr. Armstrong says that "the efficiency of a filter plant should not be lowered in any respect with the idea of making up for careless operation by the use of chlorine." Note his phrasing: "careless operation." The operator who can produce the same results from a plant at a lower cost per million gallons than the one using a larger dose of coagulants is a "careless operator" because he does not get as high a percentage bacterial removal on the filters. I believe the way this question was put influenced Mr. Armstrong's answer.

Many of those who favor dosing the water with chemicals so as to obtain an effluent from the filters of satisfactory sanitary quality regardless of the chlorine treatment seem to feel that reliance on the chlorine treatment is not a safe expedient. This is probably true for the plant that relies on one chlorinating outfit, because chlorine tanks become empty and are not always immediately replaced. The apparatus may get out of order and then the water does not receive the proper does of chlorine, thus making chlorination intermittent. In advocating economical operation by obtaining 100 per cent clarification by means of the filterr and the necessary sanitary quality by the use of chlorine, please give operators credit for insisting (1) on the filter beds and mechanical equipment being maintained in first class operating condition; and (2) on the chlorinating apparatus being so subdivided that the mechanical failure of one unit, the emptying of one cylinder without immediate replacement, will not reduce the chlorine dose below the point necessary to obtain a water of good sanitary quality.

It has been my experience that the chlorinators on the market are reliable and, if intelligently installed and operated in duplicate or multiple units, can be relied upon. Many large water supplies not filtered are successfully

and safely chlorinated by this arrangement. The cost of the equipment is small when compared to the total investment in the plant. Good engineering practice should then call for at least the duplication of the chlorinators. This overcomes the objection due to unreliability.

If the plant operators owned their plants and had to pay for the coagulants out of their profits, I do not believe they would advocate the use of more coagulant than was necessary for 100 per cent efficiency in clarification except under certain conditions mentioned later.

Some plants are fortunate in producing satisfactory effluents part of the time when dosing with just enough coagulant to obtain a good clear effluent from the filters. Others, producing a clear effluent but not a water of satisfactory sanitary quality, are troubled with odors or tastes due to the chlorine dose necessary to give the desired bacterial content. Whether this is due to primary chlorine tastes or to secondary tastes and odors due to trade wastes in the water, it is obvious that in this latter case the coagulant does should be regulated so as to obtain the necessary bacterial reduction on the filters. However, the latter case is special and does not represent the results obtained in the majority of plants.

Consider a hypothetical filtration plant representing approximate average filter plant conditions: Assume that 200 lb. of alum per million gallons are necessary to produce a clear sparkling effluent, regardless of the bacterial content; that 300 lb. would be required for an effluent of good sanitary quality, and when using 200 lb. of alum 2 lb. of liquid chlorine per million gallons would be necessary to reduce the bacterial content to the same value as would be obtained without chlorine but using 300 lb. of coagulant per million gallons. Operator 1, using 200 lb. of coagulant at 2c. and 2 lb. of chlorine at 8c., saves $1.84 per million gallons. If the 16c. used for chlorine were spent on coagulant, he would be able to use only 208 lb. Operator 1 is saving money but the consumer must be the first consideration of the operator. Both the public health and the public pocketbook should be considered since the consumer is ultimately the one who pays the bill.

Suppose, in this hypothetical filtration plant, that Operator 1 doses the water with 2 lb. of liquid chlorine just as it leaves the filters, then later on just before it reaches the pumps he gives it another 2-lb. dose of chlorine. The first dose of chlorine produced an effluent equal to that obtained by Operator 2 with 300 lb. of coagulant and the second dose produced approximately the same factor of safety that Operator 2 obtains by the use of 2 lb. of chlorine. Of course, the same effect would be produced by Operator 1 applying the chlorine all at one point. The comparative costs would then be: first operator, $4.32, and second operator, $6.16. Again the first operator saves $1.84 per million gallons.

If Operator 1 were in charge of a plant handling water requiring a large dose of chlorine to give a satisfactory plant effluent and could not double the dose on account of chlorine tastes in order to obtain the necessary factor of safety to take care of the failure of one chlorine apparatus, then the solution in this case would be the use of more chlorinators. If it were necessary to apply 3 lb. per million gallons to reduce the bacterial content to the desired point four chlorinators could be put into service, each dosing the water at the rate of 1 lb. per million gallons per day. The failure of one outfit would not have a serious effect on the quality of the water.

At the Akron filtration plant three chlorinators are installed. Two are kept in constant service, the output from each being regulated so as to be equal. Hourly reading of the weights of the chlorine tanks are taken and recorded. The third chlorinator is kept in reserve. During the past three years it has not been necessary to put the third machine into service. So much for reliability of equipment. The average yearly dose of liquid chlorine has been a little over 2 lb. per million gallons. During certain periods over 4 lb. per million gallons are used.

The editor's statement that "the consumer is the first consideration of the operator," and that "he must continually balance the public health against the form and economy of treatment," is true, but should not be used as a cloak for an inefficient business administration.

It is daily being demonstrated that it is possible with safety to the consumer to operate filtration plants to obtain 100 per cent clarification and the desired color removal, relying on the chlorine treatment for the bacterial removal. This being the most economical form of operation, it seems to me that it is the method that should be followed, except in the few special cases where trouble is encountered due to primary or secondary tastes or odors. An exception should also be made for those plants handling water subject to sudden changes in turbidity or pollution and not having large storage basins between the filters and source of supply.

Before the introduction of the use of liquid chlorine, polluted water was filtered so as to obtain a safe potable product. With the same or greater factor of safety as formerly, and with considerable reduction in operating costs, we can, by the intelligent use of liquid chlorine, supply the consumer with safe, potable water. If chlorination is resorted to as a precautionary rather than a primary measure, we are not making full use of the knowledge or science at our command.

J. S. GETTRUST,
Kent, Ohio, Oct. 11. Superintendent of Filtration.

Paint Research Not Lacking

I have seen Prof. A. H. Sabin's letter of Aug. 5, appearing in your issue of Aug. 18, p. 291. I have noted his suggestion that research work on paint be started at the Forest Products Laboratory. Such work has been under way at the above named laboratory for several years.

Prof. Sabin's reference to the difficulty of obtaining railroad specifications is also noted. He must know that there exists in Washington an interdepartmental committee on paint specification standardization. This committee, which by the way includes engineering representatives of the highest type from various railroads, has drawn up specifications for the various ingredients used in paints, as well as specifications for paste and prepared paints, used by the railroads and by the various departments of the United States Government. These specifications are obtainable, in the form of circulars of the Bureau of Standards, from the U. S. Government Printing Office. They are being widely used throughout the United States.

The writer of an editorial in *Engineering News-Record* in connection with Prof. Sabin's article (p. 262) has apparently been misled by the article referred to. For instance, he makes the following statements:

"But the entire subject of the physical action of paint coatings is closely related to the specific case referred to, and is as much involved in ignorance. Nor is there any more knowledge on the chemical problems of paint, as in fact is directly suggested by a second case which Prof. Sabin cites to support his argument."

"Among paint users there has always existed an undercurrent of belief that paint is a field of mystery. . . ."

"Such a general confession would be a significant piece of progress. It would remove one of our great industries from its state of medieval mystery and put it on a plane of scientific knowledge."

The writer of the above editorial is probably not familiar with the fact that the Paint Manufacturers' Association of the United States was undoubtedly the first industrial organization in America to undertake scientific research on a co-operative plan. This work was started as early as 1907, when the laboratories were organized and an extensive series of exposure tests inaugurated. During recent years the National Varnish Manufacturers' Association has joined in this same work, which is now conducted at the writer's laboratory in Washington. The results of the work are published monthly in the form of pamphlets for the benefit of the trade at large and for the consumers of paint as well. These publications have from time to time been issued in the form of books, several of which have been published by the McGraw-Hill Book Co. of New York City.

Washington, D. C. H. A. GARDNER,
Oct. 20. Institute of Paint and Varnish Research.

HINTS FOR THE CONTRACTOR

Mixers on City Paving Work Charged by Batch-Box Method

BY T. W. DIECKMAN
With the Lakewood Engineering Co., Cleveland, Ohio

SEVERAL Detroit contractors, including Thomas E. Currie, J. A. Mercier and Julius Porath, have developed a method of using batch boxes to charge paving mixers on city street work. This gives the following advantages: Eliminates the wheeling and shoveling crew; prevents damage to the finished subgrade, because materials are not hauled over it in wagons or trucks; and stops losses of material because none is piled directly on the subgrade—when materials are placed on the subgrade, contractors usually take a loss of 5 to 10 per cent on sand or stone, since it is not possible to clean up all of it.

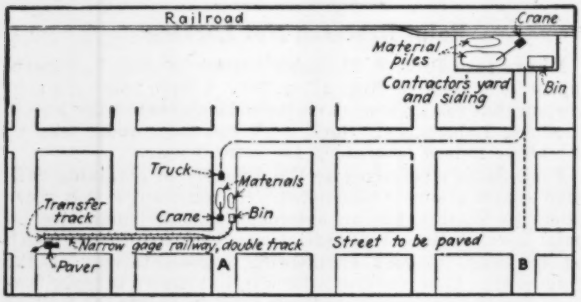


FIG. 1. BATCH-BOX SYSTEM WITH MOTOR TRUCK HAULAGE
Streets to be paved shown cross-hatched; transfer points located, in turn, at A, B and C

Sand and stone, unloaded by crane or other means at the contractor's siding, is hauled either in batch boxes on motor trucks or in bulk by motor trucks to the end of the street to be paved, or to some convenient cross street intersection. A short stretch of narrow-gage track is laid on the subgrade from this point to the mixer. If the material has been hauled in batch boxes on motor trucks, they are lifted directly on to the narrow-gage cars by a small crane, or, if the material has been handled in bulk, it is dumped on the ground or pavement and rehandled into a small portable bin by a crane or bucket elevator. The narrow-gage cars carrying batch boxes are run under this bin, charged with the proper amount of sand and stone and hauled by gasoline locomotive to the point where work is in progress.

The track is really laid as a double track from the mixer back to what is considered about a day's run. At the mixer end of this double track there is a transfer track which is a simple contrivance for moving the cars and empty batch boxes from the inside track next to the paver over to the outside track. This transfer track consists of two pieces of rail just long enough to carry the car. They are set to the track gage and are fastened on angles carrying four rollers which run in channels and allow the transfer to be moved easily from one track to the other. The transfer is mounted on a wood frame, which can easily be picked up and moved as the concreting advances. Generally a 5-car train is used; three sets of trains, or a total of 15 cars is usually required. This means that there is one train at the mixer, one at the bin or transfer point, and one in transit.

When the last batch is used from the train at the mixer, the locomotive is already there with another train of 10 batches on the inside track. These are placed, the locomotive uncoupled and backed on a switch to the outside track to pick up the empties. These are pulled down to the switch ready to be placed at the bin or transfer point as soon as the loading of the train previously placed there is completed. This method of operation insures that the mixer is at all times supplied with sufficient material to operate continuously.

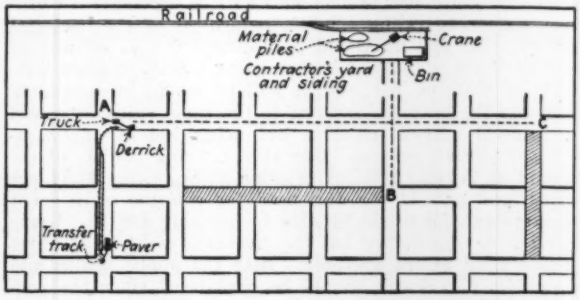


FIG. 2. LAYOUT WHEN BULK HAULAGE IS EMPLOYED
Transfer point first at A, then at B.

At the mixer the batch boxes are lifted off the running gears by the batch transfer of the paver and are swung over the skip where the material is dumped. No sand or stone is placed upon the finished subgrade, and no wagon or truck haul can damage the grading after its completion.

With this method only 3 men are required to charge the paving mixer, while with wheelbarrows a crew of about 18 would be needed. When material is dumped on the subgrade, 5 to 10 per cent of it is lost because it cannot be cleaned up. With the method here described the material never touches the subgrade, and this means a further saving to the contractor. No hauling is done over the finished subgrade, so that there is no extra cost for retrimming the subgrade. This cost of retrimming only 25 per cent of the area at 10c. per square yard, would amount to $400 per mile of 30-ft. street.

If batch boxes are hauled on motor trucks out to the street to be paved, bulk cement may be used, which will make an economy of at least 15c. per barrel, which is about $550 per mile of 30-ft. street. If bag cement is used, bags will all be handled in one place, instead of being carried out to the mixer to become lost.

A great advantage of the system is its ability to operate in weather which would close down other methods. A wet subgrade is no bar to operation. In the opinion of many contractors who have used this method, its ability to continue construction under weather handicaps is its biggest asset.

NEWS OF THE WEEK

New York, November 17, 1921

British View of Depression and Recovery Measures

Lower Bank Rate Needed for Trade Revival—Foreign Markets Discussed

In a report to the Prime Minister the executive committee of the Federation of British Industries has given its views on the causes of the present depression and on remedial measures. The suggestions include a reduction in direct taxation, export credits, loans to the Crown Colonies and the Dominions. There are views, too, on exploitation of foreign markets which have a special interest for Americans.

The fundamental causes of the depression are set down as: 1. The general impoverishment of the world, owing to the enormous unproductive expenditure. 2. The destruction of the world's standards of value, due to inflation of currencies. 3. An alteration of the world's trade channels, due to (a) the partial or complete disappearance of many pre-war markets and sources of supply and (b) the development of industries in countries which formerly exported raw materials and imported manufactured goods.

As a result there will be, first, a period during which there will be serious hindrance to international trade and, second, a longer period, which will last until the destruction of goods and means of production has been made good by hard work and restricted consumption.

STABILIZE THE EXCHANGES

Looking to amelioration of conditions in the first period it is stated that the first necessity is to stabilize the exchanges. To this end it is suggested that Great Britain join with one or more strong powers to impose a common currency policy on the rest of the world. Pressure would be brought to bear through the extension or withholding of credits, the manipulation of international debts in some cases, the reparation payments and, in the event or extreme recalcitrancy, an economic boycott. The ends to be sought would be a cessation of inflation and a balancing of budgets, followed by stabilization of currencies and "re-anchoring them to gold, though not necessarily in the same ratio as their pre-war currencies." It is suggested, also that similar pressure might be exerted to induce countries "which are constantly varying and raising their tariffs" to lower them or at least to stabilize them.

As to remedial steps affecting both periods the consideration is urged of a lowered Bank rate, to induce trade revival; an immediate and substantial reduction of direct taxation is declared to be imperative; export credits as a means of developing markets not too severely affected by the war are suggested, as are, also, loans to enable the Crown Colonies and Dominions to develop their territories. It is recog-

(Continued on p. 832)

President Signs $75,000,000 Federal-Aid Road Bill

New Act Makes $25,000,000 Immediately Available—$15,000,000 for Forest Roads—Event Marked by Special Ceremony

President Harding affixed his signature to the highway bill Nov. 9, thereby making $25,000,000 immediately available for distribution among the states for federal-aid road projects. The remaining $50,000,000 carried by the bill will become available Jan. 1. In addition $15,000,000 is made available for forest roads and trails during the next two years.

The signing of the bill was accompanied by more than the usual ceremony, so that a motion picture could be made of the event which marks the establishment of an important precedent in the government's highway policy. There was a preliminary statement by W. C. Markham, of the Kansas Highway Commission, who has been acting as the legislative representative of the American Association of State Highway Officials throughout the consideration of the bill. His remarks were followed by a statement from the Secretary of Agriculture, who pointed out that the bill contains provisions for road maintenance, which should meet the full requirements specified by the President in his message to Congress. Senator Townsend then handed a specially wrought pen to the President who signed the engrossed bill. Others who participated in the exercises incident

HOW FEDERAL-AID HIGHWAY FUNDS WILL BE APPORTIONED AMONG THE 48 STATES:

State	Allotment
Alabama	$1,553,420.67
Arizona	1,053,281.44
Arkansas	1,254,142.20
California	2,462,098.53
Colorado	1,341,175.69
Connecticut	480,897.78
Delaware	365,625.00
Florida	886,825.69
Georgia	1,997,957.58
Idaho	938,536.68
Illinois	3,246,281.07
Indiana	1,958,855.41
Iowa	2,102,872.74
Kansas	2,102,281.51
Kentucky	1,417,178.68
Louisiana	996,989.64
Maine	695,160.25
Maryland	640,629.01
Massachusetts	1,096,176.04
Michigan	2,249,532.43
Minnesota	2,123,597.07
Mississippi	1,294,906.22
Missouri	2,448,128.62
Montana	1,546,885.82
Nebraska	1,581,189.50
Nevada	953,436.78
New Hampshire	365,625.00
New Jersey	942,870.95
New Mexico	1,189,823.34
New York	3,696,447.97
North Carolina	1,709,333.90
North Dakota	1,164,714.42
Ohio	2,823,004.05
Oklahoma	1,752,339.44
Oregon	1,182,663.99
Pennsylvania	3,398,953.97
Rhode Island	365,625.00
South Carolina	1,061,237.34
South Dakota	1,204,060.31
Tennessee	1,647,692.24
Texas	4,425,172.41
Utah	849,417.21
Vermont	365,625.00
Virginia	1,456,828.47
Washington	1,103,709.77
West Virginia	802,359.77
Wisconsin	1,894,815.86
Wyoming	934,617.63

831

Agree on Paving Brick Standards

Representatives of engineering societies and paving brick manufacturers met Nov. 15 in Washington, D. C., with officials of the Department of Commerce and agreed to recommend to the several engineering societies the approval of eleven varieties of paving brick as standard, thus eliminating all the remainder of the 66 varieties now current. The 11 varieties recommended, all of them 8¼ in. long, include only four sizes, 4 x 3¼ in.; 3 x 4 in.; 3¼ x 3¼ in. and 3 x 3¼ in. Details of the deliberations and conclusions will be published next week.

Seven Bidders for Big New York Subway Contract

Bids were opened by the New York Transit Commission, Nov. 9, for the construction of the extension of the Queensboro subway from its present terminal at Grand Central Station to the west side of 8th Ave. Seven bids, all from New York firms, were received as follows:

Powers-Kennedy Contracting Corp., $3,839,000; Keystone State Construction Co., $3,895,000; F. L. Cranford Inc., $4,171,000; Patrick McGovern, Inc., $4,235,000; Booth & Flinn, Ltd., $4,389,000; Rodgers & Hagerty, Inc., $4,800,000; T. A. Gillespie Co., about $5,000,000.

In advertising for bids the Commission's engineer estimated the probable cost of this extension at $4,000,000 upward.

Prizes for Papers Offered by Illinois Society

Following the practice initiated last year, the Illinois Society of Engineers is offering five prizes of $25 for papers in five fields of engineering work: Drainage, sewerage, roads or street paving, surveying and miscellaneous civil or municipal engineering. To encourage the younger members, the competition is limited to those who have been members of the society for not more than five years, and is open also to candidates for membership. Papers, prepared according to prescribed rules, must be submitted by Jan. 1, 1922, and the prize papers will be read at the annual meeting at Decatur, Ill., Jan. 24 to 26. Particulars of the terms of the competition may be obtained from the secretary of the society, E. E. R. Tratman, Wheaton, Ill.

to the filming of the ceremony were John M. Parker, Governor of Louisiana; Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads; the senators and representatives making up the conference committee which perfected the bill and Paul Wooton, Washington correspondent of *Engineering News-Record*.

British View of Depression

(*Continued from p. 831*)

nized that these plans might involve further borrowing, and thus increase the cost of these schemes over their financing out of taxation, but it is suggested that, "this expense might well be repaid by a more rapid return of prosperity."

The work to which the suggested Dominion loans would be devoted would be state-aided immigration schemes, based on agricultural assistance. Such schemes would furnish a market for British products and also relieve the pressure of surplus population in Great Britain.

Even if all these remedies should be applied—and with success—a long period of restricted world trade is forseen. Full employment can be obtained in Great Britain during that period only if the country secures a larger proportion of the world's trade than she had before the war. Discussing the possibility of obtaining this larger proportion the report says:

COMPETITION IN FOREIGN MARKETS

"It seems probable that circumstances will to some extent assist us in this, since the creditor position of the U.S.A., coupled with the maintenance of a high tariff, makes it extraordinarily difficult for them to develop competition as against ourselves in foreign markets. At the same time it is possible that the financial and other difficulties of our European competitors will in the long run so impair their productive power as to render them less formidable competitors for some time to come than the temporary effect of the exchanges is leading us to consider them at the present time.

"In this connection it is interesting to note that there are already signs that Germany, the most formidable of these competitors, may already be becoming a less important factor. They have obtained substantially fewer foreign orders at recent international fairs, such as Leipzig and Utrecht, than they obtained last year, and there are some reports from countries adjacent to Germany that they are failing to deliver goods ordered some months ago, and that in some cases additions have been made to prices previously agreed upon.

"These indications are very slight at present, but tend to confirm the belief that the present competitive power of Germany is based very largely on artificial and temporary conditions, which must in course of time disappear, these temporary conditions, of course, being the continued inflation of German currency and the direct and indirect subsidies to the cost of living to which are due in part the lower labor costs in German manufactures."

Concluding the report are these comments on the matter of lowered costs of production:

"However favorably all or any of these causes may work for us, they can only diminish the problem. We have got to realize that if we are to sell goods to an impoverished world we must sell them at a price which that world can afford to pay, and that if foreign labor costs are below ours in any trade, either through their workmen accepting lower rates of remuneration than ours, or giving higher efficiency for similar remuneration, no artificial measures will enable us to continue to give employment in that trade.

"The lowering of the cost of production involves, of course, two factors. The first is the improvement of management, organization, and plant, and requires time, and above all the expenditure of capital, which the war and present taxation and the diminution of the world's capital resources will render it extraordinarily difficult to supply.

"The second factor is either an increased efficiency of labor in proportion to its remuneration or decreased remuneration without a decrease in efficiency. The choice before the country is to reach this result either by agreement, which would be infinitely the quickest and most satisfactory to everyone concerned, or by the sheer force of circumstances — continued unemployment, continued distress, and in the ultimate resort starvation for the workman and bankruptcy for the employer."

"Hydro" Presents Alternate St. Lawrence Scheme

At Ottawa on Nov. 14 the Hydro-Electric Power Commission of Ontario, through F. A. Gaby, Chief Engineer, laid before the International Joint Commission an alternate plan for the development of power on the St. Lawrence to replace the Wooten-Bowden scheme, noted in *Engineering News-Record*, Sept. 8. The new plan calls for two series of dams and power houses and is claimed to produce 1,600,000 hp., or 100,000 hp. more than the joint report, by a concentration of dams in the Long Sault and a minor plant near Morrisburg. Another plan was presented by W. S. Connolly, representing the New York & Ontario Power Co., for a development between Morrisburg and Waddington. At the same hearing Hugh L. Cooper, of New York, presented some engineering objections to the Wooten-Bowden plan.

New York Pier Extension Allowed, Pending New Work

By order of Secretary of War Weeks the City of New York is permitted to continue the 100-ft. extension of the piers in the Chelsea district of the North River until longer piers are provided farther up the river. This is a controversy of long standing and by order of the Secretary of War some months ago the Chief of Engineers U. S. Army, was required to shorten the two piers in question because of their menace to navigation. The city promises that longer piers will be immediately provided in the 48th St. district in the North River and contends that until such long piers are provided there will be no place where ships of the "Olympic" and "Aquitania" type can dock. On this plea the Secretary of War has granted a further extension of time.

Paterson Votes to Acquire System of Water-Works

By a vote of about 20,000 to 3,000 the electorate of Paterson, N. J., declared for municipal ownership of water-works on Nov. 8, but for no specific plan. The present supply is from the Little Falls filter plant on the Passaic River, owned by the East Jersey Water Co. and allied interests, which also own the Paterson distribution system. A similar vote in favor of municipal ownership was cast in 1910.

On the same date Paterson voted 16,000 to 7,000, against abolishing its Board of Public Works and vesting the powers and duties of the board in the City Council.

Begin Work on Industrial District for Dallas, Texas

The contract for all grading work in the new Texas & Pacific industrial district at Dallas, Texas, was let early this month and all track work is expected to be completed by Jan. 1. This district was given to the Texas & Pacific Ry. Co. in exchange for the removal of their main line from Pacific Ave., and is the result of city planning work suggested by the city's consultant, George E. Kessler of St. Louis. The total cost of the project, exclusive of the cost of the land, will be $125,000.

For the St. Lawrence Waterway

At a joint meeting of the four national engineering societies at New York City on Nov. 14 the arguments favorable to the St. Lawrence waterway and power development plan were presented by a distinguished group of speakers. The meeting was presided over by W. L. Saunders, past president of the American Institute of Mining and Metallurgical Engineers who turned the introducing of speakers over to Julius Barnes, head of the U. S. Grain Corporation during the war. The speakers were H. I. Harriman, president of the New England Power Co., Boston; Gov. Henry J. Allen, of Kansas; ex-Gov. W. L. Harding, of Iowa; and Roy S. MacElwee, recently chief of the Bureau of Foreign and Domestic Commerce.

Mr. Barnes and Mr. Harriman laid the basis of argument favorable to the proposed project in explicit terms, but the hit of the evening was made by Governor Allen, who chose to state the position of the Middle West by controverting a recent speech of Governor Miller of New York, in which the latter attacked the St. Lawrence project. In answer to the New York governor's claim that the Barge Canal would answer every purpose of navigation hoped to be served by the St. Lawrence waterway, Governor Allen said: "We are bound for Liverpool, not Buffalo,"—a concise statement of the whole pro-St. Lawrence argument.

At the outset of the meeting Mr. Saunders read a letter from various New York bodies asking that the engineering societies set aside a day for the expression of arguments against the waterway. Mr. Saunders stated that Governor Miller had been asked to this meeting but had declined.

There was a large attendance at the meeting, the main auditorium of the Engineering Societies building being filled to overflowing.

Drainage in One Missouri County To Cost $1,172,556

Ten projects for the drainage of marsh and sour lands in Grundy County, Missouri, aggregate 82 miles of large ditches to reclaim 55,680 acres at a cost of $1,172,556. With a cost of $20 to $30 per acre the land value is expected to be increased by $40. Two projects are completed, three are under contract, and five are in the preliminary stages, the estimated cost of these five being about $625,000.

Joseph Stewart, Trenton, Mo., is engineer for the Sugar Creek and two Medicine Creek drainage districts; M. H. Mooney, Trenton, Mo., engineer for Grand River drainage district No. 1, and M. Hazen, St. Joseph, Mo., engineer for the Brimson drainage district. Of the work under contract, McWilliams Dredging Co., Chicago, has 485,000 cu.yd. for the 10-mile Muddy Creek ditch; the Rinehart Construction Co., St. Joseph, Mo., has the Wilson Township ditch, and the Sampson Construction Co., St. Joseph, Mo., has 422,000 cu.yd for the 18-mile Honey Creek ditch.

Iowa Water-Works Section Against Raising Pressure For Fires

Serious objections to raising water pressure above the normal during fires were raised at the meeting of the Iowa Section of the American Waterworks Association Nov. 1-3, at Omaha. The section declared by resolution that the method was an undesirable practice and that the use of motor pumpers or other auxiliary apparatus be extended as rapidly as possible as being more suitable and economical. C. R. Henderson, manager, Davenport Water Co., stated that an excessive pressure during a fire was a mistake, due to the likelihood of breaks in mains at a critical time.

In the resolution passed are the following points: An increase of pressure in itself results in more water being discharged through the numerous leaks which always exist and more water being used through fixtures, in damage to plumbing, in the breaking of service pipes, and at time, the breaking of large water mains, all at a time when the whole water supply should be strictly conserved. Accidents to pumping machinery and valves are more apt to occur, and do occur, under the additional strain and during the excitement of raising fire pressure. An increased pressure ordinarily requires that water stored in elevated reservoirs be shut off during fires, and so made unavailable, in order to permit of direct pumping into the mains, resulting in an extra burden being placed on filter plants, and consequent danger of an epidemic following a conflagration.

In handling fires in high buildings and in the case of other serious hazards, fire departments now require large and powerful streams far beyond the capacity of domestic waterworks systems to supply. Such streams and such pressure can be furnished by motor pumpers without the hazard of raising pressure in the city mains, making more and shorter lines of hose available without the heavy expense for equipment and operation formerly required in the case of steam fire engines.

Suggest Commission of Engineers on Denver Water Problem

The Denver Civic and Commercial Association has proposed to the Municipal Board of Water Commissioners that a commission of three engineers be appointed to study and report upon the needs of the water system, with a view to inspire the citizen with confidence as to the necessity of a bond issue. The association recommends one consulting engineer of national prominence, a prominent government engineer acquainted with the water supply problem of the Rocky Mountains, and a local engineer of standing and experience. The names suggested, from which the water board might choose, are as follows: James H. Fuertes, Dabney H. Maury, and Nicholas S. Hill, Jr., for the consulting engineer; Arthur P. Davis for the government engineer; Herbert S. Crocker, L. G. Carpenter and F. C. Steinhauer for the local engineer.

Ten Hetch Hetchy Headings Advanced 4060 Ft. in October

In October the 10 headings of the mountain division tunnels of the Hetch Hetchy water supply system for San Francisco were driven by the Construction Company of North America, a total of 4,060 ft. This is the highest monthly progress yet made on the project. In the total of 679 shifts worked in October the average heading advance was 5.98 ft. The number of holes in each round varied from 25 in altered slate and schist to 50 in monolithic granite. On Nov. 1 a total of 45,073 ft. had been driven leaving approximately 50,000 ft. to go. The date on which the tunnel driving will be completed is now estimated to be about March, 1923.

International Chamber To Meet in Rome

Announcement was made recently by the American section that the second annual meeting of the International Chamber of Commerce will be held in Rome, Italy, during the week of Sept. 18, 1922. At the first annual meeting, held last June in London, there were more than 200 American business men, representing virtually every industry in the United States, in attendance. The date set for the next meeting was decided upon at a recent meeting of the council of the International Chamber held in Paris.

35 Per Cent Gain in Asphaltic Pavement Yardage

Reports from city engineers to the Asphalt Association, New York, show that over 30,000,000 sq. yds., or 1,750 miles of asphaltic pavement, 30 ft. wide, will be laid on city streets this year. Reports from state highway departments indicate that 23,000,000 sq. yd. will be laid on the state highways while the area laid in counties and other districts will bring the total to 65,000,000 sq. yd., or 3,690 miles of asphalt pavements 30 ft. wide. This will be an increase of 35 per cent over the yardage in 1920.

Southern Power Co. To Build Two New Plants

The Southern Power Co., through the office of W. S. Lee, vice-president and chief engineer, has announced that it has just let contracts for the wheels and generators for the two new stations on the Catawba River.

The first of these is an addition to the present plant at Great Falls, S. C., and will be known as Great Falls Power House No. 2. The machinery contracts now let call for three units, each of 18,750 k.v.a. capacity. In the plant construction are involved 35,000 cu. yd. of concrete masonry and 100,000 cu. yd. of excavation. The dam at this point is already constructed, and the wheels will operate under a head of 72 ft.

The second new installation is to be made at a point 12 miles from Charlotte, N. C., and will be known as the Mountain Island Station. This will be an entirely new installation. The work required includes the building of a dam, penstocks, power house, etc. Four 18,750-k.v.a. units are to be installed. The construction work includes 220,000 cu. yd. of concrete masonry; 250,000 cu. yd. of rock excavation and 400,000 cu. yd. of earth fill. The head at this plant will be 80 ft.

The wheels and generators in the two plants will be of identical design. The wheel contract has been let to the S. Morgan Smith Co. and the generator contract to the Allis Chalmers Co. Contracts for the construction work are to be let shortly.

Jersey City Favors Municipally-Owned Gas Works

A majority of nearly 31,000 votes was cast in Jersey City on Nov. 8 in favor of acquiring or building gas works for light, heat and power for both public and private use. No plan of action has yet been adopted.

Bureau of Standards Studies Soil Corrosion on Iron and Steel Pipe

The Bureau of Standards has recently undertaken an extensive investigation of the corrosive action of soil on pipes used for gas and water mains and services. In this investigation the Bureau of Standards has the co-operation of the Bureau of Soils of the Department of Agriculture, pipe manufacturers and the public utilities. Forty locations have been selected as representative of the principal families of soils to be found throughout the United States and in them will be buried a number of samples of every kind of iron and steel pipe in commercial use.

Complete data on the physical and chemical properties of the soil will be obtained, also the chemical analyses of the pipe, their microstructure, and complete metallurgical heating will be determined. Extensive laboratory experiments will be conducted to determine the effects of variations in individual characteristics of both soils and pipe materials. Some tests of representative pipe coatings will also be undertaken.

It is expected that a good deal of data as to the relative rates of corrosion of different kinds of pipes in the soils under observation will be obtained within two or three years, but the experiment will probably continue over a period of eight or ten years. Progress reports will be published periodically.

Plan To Tap Lake 45 Feet Below Water Level

The Tule and Baxter Creek Irrigation Districts in northern California have contracted with Leon Bly for the construction of a complete irrigation system to provide 50,000 acre-ft. of water per annum, and to cost $1,250,000. The contractor is to turn the system over to the districts with water rights, rights-of-way, structures, etc., complete and ready for operation. The two districts involve a total of 25,000 acres in the Honey Lake basin and the water supply is to be taken from Eagle Lake.

The plan proposes a distribution system by means of an 8,000-ft. tunnel that will tap the lake 45 ft. below water level. There are approximately 1,000,000 acre-ft. in the lake above the proposed tunnel level. If the level is drawn down 45 ft. below the present height, the area of the lake surface would be reduced from 30,000 to 8,000 acres and the saving in evaporation on this 22,000 acres is expected to be enough to supply the annual requirements of the districts.

Features of the distribution system will be a 5,000-ft. flume to carry 250 sec.-ft., and several large siphons, one of which will be 52 in. in diameter and 16,000 ft. long. The area to be irrigated is largely sage-brush lands, most of which are now desert. The scheme for tapping Eagle Lake has long been under consideration; a tunnel was started in 1873 but never finished.

T. H. Means of the Cope, Rand, Means Co., San Francisco, is engineer for the irrigation districts.

California Objects to High Road Costs for Heavy Trucks

Pointing out that in the production of motor trucks in the United States in 1920 only 2 per cent were of 5-ton capacity and only 1 per cent over 5 tons, the California Highway Commission has issued the following statement, which raises the question of the advisability of adding greatly to road construction costs for the sake of a comparatively few users:

"As the ratio of use must be in close proportion to the ratio of production, it follows that only about 3 per cent of vehicles using California State highways are of the so-called heavy duty type. This year there were approximately 40,000 trucks of all kinds registered in the State, which indicates only about 1,200 to 1,500 trucks of 5-ton or more capacity.

"Highway construction, like other governmental activity, is based on public necessity, and this necessity should be met reasonably when highways are built, adequate to sustain 90 per cent of the traffic. In California this percentage will include all motor, and other vehicles, up to and including two ton capacity. Assuming that for $30,000 per mile an improved highway can be built adequate to sustain 90 per cent of the vehicular traffic of the State, but that it will require $50,000 per mile to construct a highway which will sustain the weight required by 10 per cent of heavier-duty trucks, should the general tax payer be required to invest an additional 66 per cent in road construction for the exclusive benefit of this particular class of heavy vehicles?

"In California highways are being constructed from bond funds provided by general taxation. Motor vehicle license fees are inadequate to provide funds necessary for proper maintenance, and the fees bear no relation to the wear and tear to which the vehicle licensed subjects the highway. The legal weight limit here is equaled by only three other states in the Union."

Ask Bids To Build Piers of Philadelphia Bridge

Bids to construct the two main piers of the Delaware River bridge to connect Philadelphia and Camden are asked by the Delaware River Bridge Commission, 806 Widener Bldg., Philadelphia, until 3 p.m., Dec. 19. The piers, located approximately at the pierhead lines, are to be sunk to bed rock by the pneumatic caisson process. They will be 70 x 143 ft. each.

Civil Service Examinations United States

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

One vacancy in each of these positions in the Bureau of standards, Department of Commerce, Washington.

Structural Engineer, $3,600 to $4,800 a year.

Associate Structural Engineer, $2,500 to $3,600 a year.

Assistant Structural Engineer, $1,800 to $2,400 a year.

Junior Structural Engineer, $1,200 to $1,500 a year.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, New York City, Nov. 8-19.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

The Engineers Club of Seattle, (Wash.) has leased the College Club Building as its new headquarters.

The Houston (Tex.) Engineers' Club, on Nov. 1, was addressed by Dr. Edward Ardern of Manchester, England, on "Activated Sludge Process."

The Webster City Engineers' Club of Webster City, Iowa, Oct. 29, was addressed by E. E. Schenk, on "What the Club can do for the City," and by Prof. J. H. Dunlap on "Is the Present Engineering Education Adequate?" Mr. Schenk argued that the engineer should mold public opinion to the attainment of better public improvements. Following Prof. Dunlap's talk a committee on the education an engineer should receive was appointed to collaborate with active Iowa clubs and report to the Iowa Engineering Society in January at Sioux City.

The Princeton Engineering Association of New York, composed of technical graduates of Princeton University, has created "The Cyrus Fogg Brackett Lectureship in Applied Engineering Technology." The lectures will be given at Princeton and the speaker at the first meeting, Dec. 1, will be Samuel Insull, president of the Commonwealth Edison Co., Chicago, on the subject of "The Production and Distribution of Electric Energy in the Central Portions of the Mississippi Valley."

The Allied Engineering Association, Charleston, S. C., at its Oct. 17 meeting was addressed by Col. Eugene Kelly, manager of the White Truck Agency, Charlotte, on the motor truck, its uses, cost and maintenance, and also on good roads.

The Society of American Military Engineers, New York Post, at its meeting Nov. 1, in the Engineering Societies' Building, New York City, was addressed by Maj. George W. Johnson, of Columbia University, on "Strategy and Tactics of the Great War in Their Relation to Geographical and Geological Features of the Theatre of Operations." The talk was illustrated by lantern slides.

Engineering Institute of Canada—At a recent meeting of the civil engineers of London and St. Thomas, Can., preliminary plans were made for a formation of a branch of the Institute. Organization will take place Nov. 16. At the preliminary meeting, H. A. Brazier, city engineer of London, was elected chairman.

PERSONAL NOTES

HARRY L. MAIER, formerly engineer in charge of sewers, Street and Sewer Department, Wilmington, Del., has been appointed chief engineer, succeeding Edgar M. Hoopes.

JAMES W. PHILLIPS, chief of the grade-crossing division of the Bureau of Surveys, Philadelphia, has been engaged to represent the City of Minneapolis in a suit involving $12,000,000.

A. CRAINE, formerly division engineer of the Chicago, Burlington & Quincy R.R. St. Joseph, Mo., has been appointed district engineer, maintenance of way, with headquarters at St. Louis, Mo.

GEORGE POSEY, who recently has assisted in preliminary surveys of the Sacramento-Woodland railroad and in Richmond harbor developments, has been appointed surveyor of Alameda County, Cal.

DONALD E. A. CAMERON, formerly engineer with Robinette-Bruyere-Cameron, Toledo, Ohio, has been appointed chief engineer for the Watts & Suhrbier Co., general contractors, Toledo, Ohio.

RICHARD A. HALE has been appointed chief engineer of the Essex Co., Lawrence, Mass., to fill the vacancy caused by the death of Hiram F. Mills. As resident engineer, Mr. Hale took charge of the Essex Co. work in 1892, when Mr. Mills went to Lowell. Later on, Mr. Hale was made principal assistant engineer. Although Mr. Mills held the title of chief engineer up to the time of his death he had not visited Lawrence nor taken any active part in the Essex Co. for the past ten years.

J. E. BARLOW, formerly city manager of Dayton, Ohio, has been appointed city manager of New London, Conn.

THE RANDOLPH-PERKINS Co., engineers and manager, successor to Isham Randolph & Co., the Edmund T. Perkins Engineering Co., and the George B. Massey Co., has incorporated with offices in Chicago. The officers of the company are LeRoy K. Sherman, president; George B. Massey, vice-president; Charles T. Mordock, treasurer; and Robert Isham Randolph, secretary. Mr. Sherman was formerly chief engineer and vice-president of the Edmund T. Perkins Engineering Co. Mr. Massey is a mechanical engineer specializing in excavating machinery and methods. Mr. Mordock was formerly Chicago representative of the J. G. White Co. and specializes in public utilities. Mr. Randolph was formerly senior partner of the Isham Randolph & Co., specializing in land drainage, levees and pumping plants.

THEODORE F. LEIST, formerly major of engineers, Construction Division, U. S. Army, and recently architect of the central district with the bureau of valuation, Interstate Commerce Commission, has been made Chicago representative of the National Lumber Manufacturers' Association.

OBITUARY

SAMUEL M. GRAY, consulting engineer, of Providence, R. I., died in Slocum, R. I., Nov. 5. A sketch of his professional experience, which included 31 years of practice, mainly in the fields of water-works and sewerage, will appear in next week's issue.

COL. GEORGE H. WEBB, chief engineer, Michigan Central R.R. since 1905, died Nov. 3 in Newton, Mass. He was born in Dubuque, Iowa, in 1860 and was graduated from the Pennsylvania Military College in 1880. His first position was that of rodman with the Baltimore & Ohio R.R.; later he was levelman and transitman with the Pittsburgh Southern Ry. and division engineer Pittsburgh & Western R.R. Leaving railroad work in 1883 he became city engineer of Johnstown, Pa. and in 1884 was made engineer in charge of construction work for the Johnson Steel Street Rail Co. Later he returned to railroad work as assistant engineer on branch lines of the Chicago, Burlington & Quincy R.R. and from 1889 to 1891 he was engaged in the construction of government railways in Chile, for two years of this time as division engineer of the North and South American Construction Co., in charge of all construction. He then became division engineer and superintendent of construction, Summit division, Central Ry. of Peru, through the main range of the Andes. From 1893 to 1897 he was engaged in private engineering practice, and then became chief engineer of the Cincinnati, Georgetown & Portsmouth Ry. His connection with the Michigan Central began in 1903, when he located the Ostimo division. During the war he was lieutenant-colonel of the 16th Engineers in France and later served as section engineer, intermediate section, (east) of the Division of Construction and Forestry of the A. E. F., at Nevers.

HOWARD C. HOLMES, civil and consulting engineer of San Francisco, died in that city on Oct. 30. He was born in Nantucket, Mass., in 1854. He went to San Francisco and started at an early age as a surveyor; when he was nineteen years old he made the topographical survey for the development of Lake Chabot. For some years he was assistant engineer of the California State Board of Harbor Commissioners and later chief engineer. Early in his career he gave attention to the construction of cable railways and was identified with both design and construction on a number of the San Francisco cable systems as well as similar lines in Seattle, Portland and Spokane. He had charge of the foundation work on the San Francisco Ferry Building and carried out the construction of the Alameda mole, the Key Route Mole, the greater part of the Oakland, Alameda and Piedmont Railroads, the yacht harbor and freight and passenger terminal at the 1915 Panama Pacific Exposition and the Hunter's Point drydocks. He was at different times the former consulting engineer of the Massachusetts Harbor and Land Commission, the Esquimalt Shipbuilding and Drydock Co. of British Columbia, the Port of Portland Dock Commission, the Bethlehem Shipbuilding Co., the Moore Shipbuilding Co., the Western Pacific R.R. and other corporations.

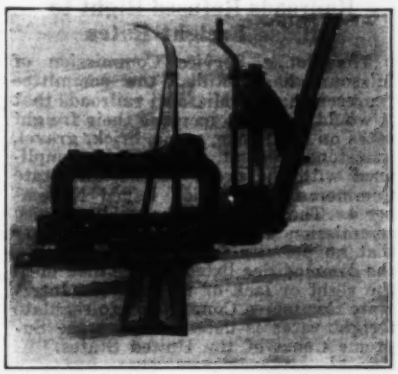
WILLIAM E. BAKER, civil engineer, died in New York City Nov. 7. He was born in Springfield, Mass., 1856, and was graduated from Lafayette College in 1877, of which institution he was a trustee for many years. From 1877 to 1888 he was engaged in railway work on the engineering staff of the St. Paul & Pacific R.R. as transitman and engineer; as transitman with the engineering staff on the survey of the Canadian Pacific Ry. through the Rocky Mountains; and as resident engineer in charge of bridges and buildings of the International & Great Northern Ry. From 1888 to 1892 he was with the Thompson Houston Electric Co. in charge of installation of electric equipment of the West End Street Ry., Boston, Mass. He was general manager of the Columbian Intramural Ry., at the World's Fair in Chicago and later general superintendent and general manager of the Metropolitan West Side Elevated R.R., Chicago.

MAJOR-GEN. PETER C. HAINS, U. S. A., retired, Civil War veteran, and former member of the Isthmian Canal Commission, died at Washington, D. C., Nov. 7. He was born in Philadelphia in 1840 and was graduated from the U. S. Military Academy at West Point in 1861. He was commissioned second lieutenant in the Second Artillery on June 24, 1861, and two years later was transferred to the Corps of Engineers, being promoted through the several grades until he became a brigadier-general in 1903. During the Civil War, he served in the defenses of Washington, in the Manassas campaign and was engaged in the battle of Bull Run. He was in the Virginia Peninsular, Maryland and Rappahannock campaigns, and was chief engineer of the Thirteenth Corps from March until July, 1863. In 1862 he was brevetted captain "for gallant and meritorious services" in the battle of Hanover Court House, Va.; major, in the same year, for services during the siege of Vicksburg, Miss.; and lieutenant-colonel, in 1865, for services during the war. He served also in the Spanish-American war as brigadier-general of volunteers and was in command of the Third Division, First Army Corps, and later was in command of the Second Brigade, First Division. He was a member of the Nicaragua Canal Commission in 1897 and 1898 and later served as a member of the Isthmian Commission. His army assignments included numerous works of harbor and river improvement and harbor defense. He retired from active service in the army in 1904. He was appointed major-general, U. S. A., in 1916, under a special act of Congress and was assigned to active duty in 1917 as engineer, Norfolk Harbor and River District. He retired from active service in 1918. Gen. Hains developed the concrete mixer which bears his name.

EQUIPMENT AND MATERIALS

Lever-Handled Hacksaw

A portable hacksaw for cutting rails and steel shapes, brought out by Crerar, Adams & Co., of Chicago, has the frame clamped to the rail or shape to ensure



a straight cut and the saw is operated by a long lever so that the work is faster and less laborious than operating a hand hacksaw. The frame is adjustable to any width up to 9 in. and to any horizontal angle up to 45 deg. Saws 14 to 17 in. long are used, and the machine in working order weighs about 110 lb. Track, bridge and building construction and track maintenance are the fields of work for the new hacksaw. It is stated that a 90-lb. rail can be cut in 30 minutes, a 125-lb. 9-in. grooved girder rail in 45 minutes, and a 9-in. I-beam in 25 minutes.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Railroads Show Operating Gain

The net operating income of 197 Class 1 railroads amounted to $82,707,607 for September, 1921, an increase of 11 per cent reported for September, 1920. This report lacked four roads to be complete. Road revenues for the month were $479,938,638, a decrease of 19.7 per cent compared with the amount a year ago. Operating expenses for the 197 roads were 26.2 per cent less this year than in September, 1920. Expenses this year stood at $865,342,237. In August the roads reported net railway operating income of $90,241,103.

The greatest single saving in expense was accomplished by the eastern district which cut its operating cost 29.8 per cent.

Railways Placing Orders For New Equipment

The Chicago, Burlington & Quincy R.R. and the Colorado & Southern Ry. Co. have been authorized to purchase $15,000,000 worth of new rolling stock, and it is understood that immediate arrangement is to be made for the purchase of 7,300 freight cars, 55 heavy freight and passenger locomotives and 127 all steel passenger cars. This decision was made on the "belief that there is a decided upward tendency in traffic and that before long additional facilities will be required to meet the transportation demands of the country."

A report has been made also that the Illinois Central R.R. Co. has placed orders for 900 cars, at an aggregate cost of $2,660,000 and has invited bids for 2,000 coal cars to cost $4,000,000.

Railroads Refused Right to Raise Freight Rates

The Public Service Commission of Missouri has notified the committee representing the Missouri railroads that it would refuse to increase their freight rates on coal, coke, stone, brick, gravel, limestone, cement, oil, etc., in compliance with the order of the Interstate Commerce Commission issued November 4. The refusal of the public service commission is construed as meaning that no permits for higher rates upon the commodities listed will be filed until the right or lack of right of the Interstate Commerce Commission to regulate freight rates is determined by the Supreme Court of the United States.

Labor Paragraphs

The 79 member firms of the Employers' Association of Detroit added 4,400 workers to their pay-rolls, making the total at work 115,800, although half are on part time schedules.

Sacramento is in urgent need of building labor of all classes. Lowered material prices are reported to have increased construction.

Bricklayers now place 1,300 brick per day as against 600 to 700 in war days, according to W. L. Rathmann, president of the St. Louis Chapter of the American Institute of Architects.

Trend of Business

Stock Market—Better tone resulting from good news from iron and steel industry, improved demand for copper, good railroad reports, and the upward trend of the bond market. Total sales last week were 2,484,337, as against 6,641,461 a year ago; high average of fifty stocks was about 67 as compared with nearly 80 in the same week last year.

Bonds—Slight check on buying, probably due to unloading by those who bought at low prices eight or ten months ago. New issues were heavy for a three-day week, totaling $55,000,000. Two industrial issues—Goodyear Tire & Rubber Co. 8 per cent sinking fund debentures, due 1931, at 99½, and Wilson & Co. ten-year 7½ per cent convertible debentures, at 96½—amounted to $37,725,000. Municipals strong throughout the week.

Money—No stringency, and easy money expected to the end of the year. Following is range of ruling call money loans last week and for the same period in other years: 5½ per cent; 9 per cent in 1920; 8 in 1919; 6 in 1918; 4 in 1917; 2½ in 1916; 1½ in 1915, 5½ in 1914. Total exchanges of checks last week (two holidays) in New York, as reported by the Clearing House was $2,840,410,705 compared with $4,665,924,290 the preceding week.

Foreign Exchange—German marks dipped to .33 cent. Other markets generally inactive.

Textiles—Census Bureau reports that cotton actually ginned prior to Nov. 1 amounted to 6,646,136 bales against the Department of Agriculture's forecast in October of 6,537,000 as the total yield. A net 1921 crop of 7,500,000 bales is predicted. The contract cotton market has dropped $9 as a result of the Census report; spot down $6. Thus, with ample supply, prices are not expected to go higher.

October Steel Production was one-third greater than for September. October steel ingot production was at the rate of 23,000,000 gross tons per year, or 44 per cent of estimated capacity. The Corporation's unfilled tonnage decreased 273,841 tons last month. Steel prices are slightly weaker than last week.

Chicago Committee Proposes to Enforce Landis Award

A committee of citizens of Chicago has been formed to bring about a full adoption and enforcement of the terms and conditions laid down two months ago by Judge Landis in the building arbitration decision.

The reasons for the establishment of the committee were summed up by J. W. O'Leary at the organization meeting: "In spite of his efforts and the agreements of contractors and building trade unions to participate in the arbitration some contractors and unions have proceeded with work in Chicago without regard to the award. . . . The committee is making no fight on trade unions as such. Those unions which, in letter and in spirit, have accepted the Landis award and are working under it, will have the support of the committee in their action. Those crafts which withdraw from the award or refuse to accept its conditions automatically place themselves beyond the support of the public. Those contractors who have entered into agreements with unions outside of the award deserve neither the consideration nor the support of the public."

More than 150 citizens have already enrolled and all the money necessary to carry on the work is said to be available. Addresses have been made by leaders of a similar movement in San Francisco where it is said $1,000,000 was available in a similar campaign to clear up the restrictions on the building industry.

New Roads for New Jersey to Cost $1,885,741

Road building contracts aggregating $1,885,741 will be awarded by the New Jersey State Highway Commission as a result of President Harding's conference on unemployment giving $942,870 in federal aid to New Jersey. The national appropriation was voted with the understanding that New Jersey would match whatever appropriation was forthcoming. New Jersey's allotment comes out of the $75,000,000 available for road work. Governor Edwards wired the Government that "New Jersey will immediately prepare to contract for new roads as a result of this action."

Building Trades Employers Make Survey of New York City

A complete survey of conditions in the building industry in New York City is being undertaken by the Building Trades Employers' Association upon which the 1922 wage agreement between employers and employees will be predicated. The survey will reveal exactly what is to be expected in the volume of construction needed and likely to be contracted for under a given set of conditions. It is also hoped that information will be secured which will indicate the attitude towards construction of building and loan associations, banks

and other financial institutions having money to loan for construction purposes.

The employers association feels that labor and materials are not alone responsible for the holding up of work, and cites several examples in support of such a contention. It points to Philadelphia, for instance, that despite a 23 per cent reduction in wages, still lacks construction of any magnitude.

similar reduction is to be sought. It is not known exactly what the reduction will be but it is believed it will approximate 10 per cent for all operatives in the eastern and western districts. The wage reduction will affect approximately 1,650,000 railroad workers of all classes.

It is understood, however, that the new wage reduction, if granted by the Railroad Labor Board, will be translated immediately into reduced railroad rates, with the agreement of the Interstate Commerce Commission. Executives have been in conference with the Interstate Commerce Commission in order that a full and final understanding of the situation may be made clear.

Inasmuch as the Railroad Labor Board has made known that it plans to clear up its docket insofar as questions concerned with wages and working conditions are concerned before new wage rates are considered, it is possible that the consideration of the proposed wage reduction will not be arrived at by the Railroad Labor Board before three or four months. However, it is believed in railroad circles that the Railroad Labor Board will not long hold off consideration of the proposed reduction if an immediate translation of that reduction into lower railroad rates is quite possible of realization.

Do You Know the Business Side of Construction?

THE KIND of business information published weekly by *Engineering News-Record* needs to be read by all engineers, contractors and materials producers and dealers who hope to keep up with the business of their profession and industry. *Engineering News-Record* keenly recognizes the need for economizing readers' time. Expert, inside knowledge of finance and trade can come only with deep and continual study of the multifarious elements that make up modern business. Financial leaders employ such students of business to keep them and their executives informed of the movements in industry and the meanings of the movements. *Engineering News-Record* gives a rapid survey of business in general and of construction affairs in particular.

A general knowledge of the trend of business, as referred to the construction industry, is essential to the successful conduct of engineering and contracting enterprises. Such knowledge goes a long way toward assuring the success of both the organization and the individual. It is this knowledge that *Engineering News-Record* is offering each week in its BUSINESS SIDE OF CONSTRUCTION.

The Regular Features of This Department Consist of the Following:

MONTHLY PRICES OF CONSTRUCTION MATERIALS. — *Including "Ups and Downs of the Market."*

LABOR RATES AND CONDITIONS THROUGHOUT THE COUNTRY. — *Covering seven classes of labor in twenty cities.*

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER.—*Giving comparison of current cost with cost in 1913.*

ENGINEERING NEWS-RECORD CONSTRUCTION VOLUME INDEX NUMBER.—*Giving amount of contracts let per month and per year in terms of 1913 values.*

CONTRACTS AWARDED EACH MONTH. —*Value of contracts let in each class of construction.*

TREND OF BUSINESS.—*Highlights in finance and human relations—stock, bond and money markets, wholesale and retail prices, cost of living.*

SKETCH OF PUBLIC BOND SALES EACH MONTH. — *Presenting essential data on some thirty representative issues of state, county and municipal bonds.*

MATERIAL STOCKS AND PRODUCTION. —*Showing time required to get materials on the job in the important cities.*

IN ADDITION to these standing features there is a stream of special studies, which completes the picture of construction activity. Just a few of these since March this year:

SPRING PRICES OF CONSTRUCTION MATERIALS SINCE 1913.—*Giving prices of all the important materials for April, May and June of each year since 1913, and an interpretation.*

CEMENT AND STRUCTURAL SHAPES COMPARED FOR 21 YEARS.—*With charts and a table of annual production.*

CEMENT, LUMBER AND STEEL BEFORE AND SINCE THE WAR. — *Prices over nine to twelve years, with charts. Comparison of prices with production.*

WHOLESALE COSTS — CONSTRUCTION AND LIVING. — *General construction costs compared wtih wholesale prices of all commodities and with special groups of commodities.*

FREIGHT RATES ON PRINCIPAL BUILDING MATERIALS. — *Showing actual shipping cost to contractor.*

WAGES AND THE COST OF LIVING.— *Relation between wholesale and retail prices shown. Actual decline in living cost established.*

CONSTRUCTION NEWS hardly needs an introduction to readers of *Engineering News-Record.* This is the department where jobs are found —jobs for the contractor's organization and for the individual. In 1920 a total of 26,986 items were published, of which 11,709 called attention to proposed work, 6,028 announced bids desired, and 9,249 contracts let. Every one of these items was sent in by our regular correspondents. Construction News is 100 per cent verified.

All this is the business side of construction as conceived and carried out week by week by *Engineering News-Record.* Modern business is complex. It is not enough to know only the little world of one's own organization. The cement man must know about brick and hollow tile, the brick man must know about cement and tile, the steel man about lumber, and all must follow the broad trends of the construction industry. The contractor must know the prices and availability of materials and labor, where to obtain jobs, and at what rate he can borrow money. The engineer must know the prices and availability of materials and labor, where to obtain jobs, and at what rate he can borrow money. These, and more, are the BUSINESS SIDE OF CONSTRUCTION.

Railroads to Push Plan To Secure New Wage Reduction

Following an announcement made by managers of a western group of railroads at a meeting held in Chicago November 7 that immediate posting of notices of wage reductions of 10 per cent would be made, executives of the railroads in the classification territory east of the Mississippi and north of the Ohio River have announced that a

Heavy Freight on Lumber Injures the Industry

"As long as it costs more to transport lumber from the sawmill to the consumer than it costs to make the lumber in the first place, conditions in the lumber industry will never be satisfactory," said a prominent lumberman in Washington a few days ago. He cited the instance of a car load of 2 x 4's sent from Tacoma to Buffalo, the freight